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VOLUME XXVIII SAN FRANCISCO, MARCH 16, 1912 NUMBER 11

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TRANS-BAY CABLE OF GREAT WESTERN POWER CO.[1]

BY SAMUEL D. NAPHTALY.

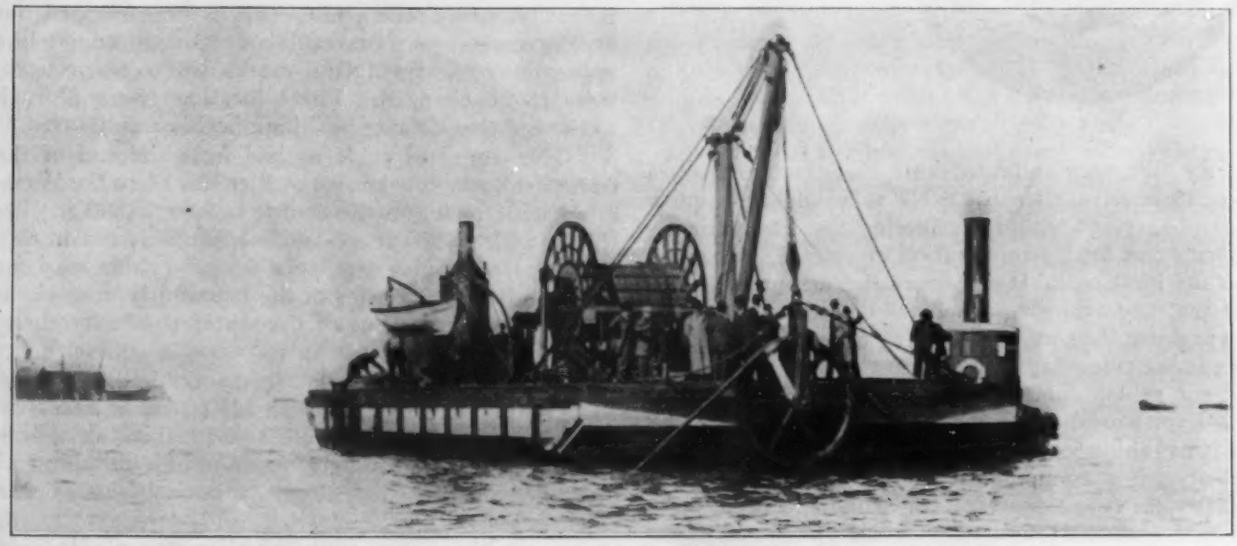
The problem of laying a submarine power cable across San Francisco Bay was first considered by the writer in 1902 and 1903, when connected with the San Francisco Gas & Electric Company. At that time the Standard Electric Company was endeavoring to deliver current into San Francisco over their transmission line along the peninsula from Mission San Jose. The fog and other conditions made the delivery so unsatisfactory that a solution in a submarine cable was considered. Not being able to arrange satisfactory terms, the possibility of this source of supply was dispensed with and not until 1905, after the purchase of the San Francisco Gas & Electric Company by the Pacific Gas & Electric Company, was the matter again taken up, the idea being to transmit power from the First and Grove Street Station in Oakland to Station C on Jessie street on the San Francisco side.

In the latter part of 1906 the subject was again revived and carried so far as to receive permission from the commandant at the Goat Island training station to land the cable on either side of Goat Island with the idea of carrying an overhead line across the island in close proximity to the present overhead telephone lines, but nothing more definite was done at that time.

The Great Western Power Company also gave some study to the problem during the early construction period of its plant in 1906-07.

From time to time, however, in order to keep in touch with the development of the submarine cable, much discussion was had with the different manufacturers and many types and various schemes were proposed by them, some suggesting three single conductors in separate leads, others triple conductor, some steel and some copper armor. No reliable progress was made and the scheme was dropped until the year 1910 when the City Electric Company gave some attention to the problem with a view of delivering current to Oakland from its steam plant at North Beach.

The acquisition of the City Electric Company by the Great Western Power Company placed both concerns under one management and immediately the advantages of a connection between these two growing concerns became apparent. The City Electric Com-



Laying Great Western Power Company's Cable Across San Francisco Bay.

[1]Paper presented before San Francisco Section, A. I. E. E., February 26, 1912.

pany, supplying a demand in San Francisco of approximately 13,500 kilowatts, needed an independent and reliable source of power. The Great Western Power Company, with its 40,000 kilowatt, modern hydroelectric development on the Feather River, needed the regulating advantages at this end of its 153 mile transmission line that the steam turbine plant of the City Electric Company afforded. These obvious advantages, together with the economics which the introduction of hydroelectric power would mean to the consolidated companies, were immediately apparent, and plans were started for the placing of a submarine cable under the waters of San Francisco Bay.

The general problem involved a selection of voltage and design of cable best suited to the conditions as they existed, the distributing potential of the Great Western Power Company in Oakland being 12,000 volts and of the City Electric Company in San Francisco—11,500 volts "Y," with grounded neutral.

Cable Cross-Section.

By this time, all the cable manufacturers were eager to construct such a cable as would accomplish the end in view, but in considering the size, carrying capacity and final determination of voltage, all agreed that the limit of cable sizes was the maximum diameter that the armoring machines would take care of The problem then was, considering maximum diameter, voltage, carrying capacity and cost, to select the most efficient cable. The use of a potential greater than 12,000 volts meant increased insulation and decreased radiating ability, and consequent decreased carrying capacity. For example, a 3 conductor, No. 2 cable for 22,000 volts (the same external diameter as No. 0000, the cable selected) figured on a maximum safe temperature of 150 degrees Fahrenheit would give 4150 k.v.a., while a 3 conductor, 0000 for 12,000 volts would give 6200 k.v.a. when submerged in 55 degree water. Consequently, a selection of the 3 conductor, 0000 cable for 12,000 volts working pressure of cable.

While the several manufacturers varied somewhat in their suggestions, from the all Para rubber unleaded, to a leaded, paper insulated cable, the consensus of opinion was a cable of the following specifications, which was finally ordered from the Standard Underground Cable Company:

Three conductor, 0000, B. & S. gauge, each conductor being made up of 19 soft drawn strands, concentrically stranded together. Conductivity not less than 98 per cent, according to Matthiessen's Standard. Conductors are tinned as a protection against vulcanizing compound. The insulation on individual conductors is: 1st, 5/32 in., 30 per cent Para rubber; 2d, One layer of rubber-faced tape over the rubber insulation, with 1/8 in. lap; 3d, 2/32 in. varnished cloth over the rubber tape. The separately insulated conductors are twisted together with a pitch of about 24 in. and a jute filler saturated with insulation compound is used to round out the conductors before the belt or outer jacket is applied. The outer insulation belt consists of 6/32 in. varnished cloth, making a total insulation between conductors of 14/32 in., and between conductors and sheath 13/32 in. The lead sheath is 1/8 in. in thickness and contains 2 per cent tin. Outside the lead sheath is a serving of 4/32in. tarred jute and over this jute is an armor of 37 No. 4. B. W. G. galvanized steel wires with a pitch of about 24 in. Over the armor is a serving of 4/32 in. tarred jute with a lime and sand finish.

The cable was tested at the factory at a potential of 32,000 volts between conductors, and between conductors and lead sheath for a period of 30 minutes.

The diameter over all is 3.75 in. and the weight is 17½ lb. to the foot.

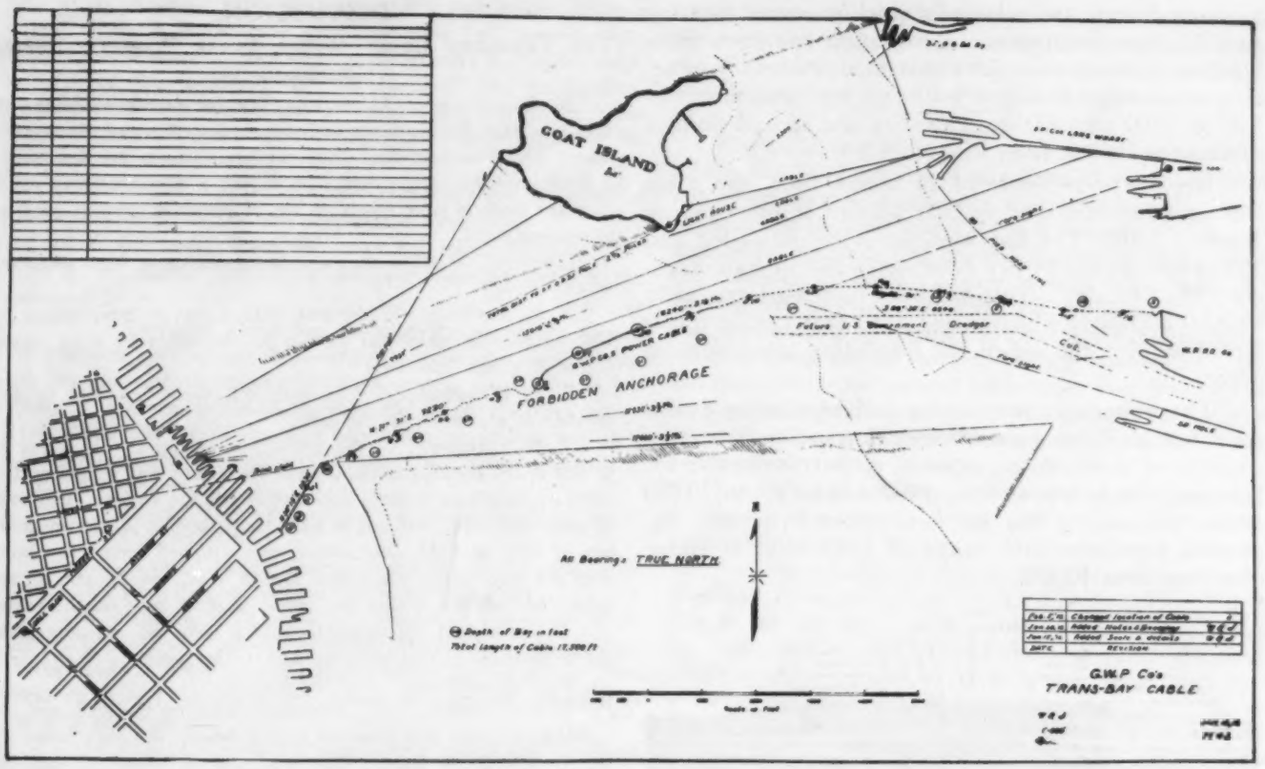
Permission was granted by the Secretary of War for the installation of this cable between the Western Pacific mole on the east bay side to the old army transport dock on the San Francisco side, over a certain route which is laid almost entirely in the forbidden anchorage and which bore to the north so as to avoid the new ship channel which is to be dredged westerly from Oakland Creek. The courses were mapped out and several runs were made over the arranged line so as to obtain fixed land marks where the courses were to be changed. These locations were plotted, to the end that definite position of cable was assured.

The length of cable as laid from the end of the transport dock, now known as Pier No. 12, to the Western Pacific mole, on the course laid, is 18,800 ft. To this is added 1000 ft. of triplex, 300,000 circular mill lead encased, double steel tape armored cable used for shore ends on both sides of the bay and leading along under the wharves out of the water to the overhead construction.

The manufacturer found it impossible to make the cable up in longer lengths than 1250 ft. The necessity of laying this cable in one piece and making all splices ashore was evident and the question of a suitable reel presented itself. Accordingly, a horizontal reel was constructed with a steel shaft and arrangement of truss rods, having a minimum diameter of 11 ft., a length between heads of 26 ft., and a maximum diameter of winding space of 18 ft. To accommodate this reel and its weighty load, it was necessary to have a barge of extraordinary stability and we fortunately succeeded in leasing a car float from the Santa Fe Railroad. This float is 37 ft. wide and 200 ft. long and is equipped with pilot house and rudders. The superimposed load was as follows: cable, 350,000 lb., reel 90,000 lb., boiler and engine (used for paying out) 20,000 lb.; total, 460,000 lb.

The run for laying of cable was made with a tug boat on each side of the barge and a third tug standing by for emergency use. The running speed varied from 200 to 500 ft. per minute.

The cable being laid in forbidden anchorage water, there is a minimum liability of interference from ship's



Map of Cable Crossings of San Francisco Bay.

anchors, and the depth of water varies along the course from a minimum of about 15 ft. to a maximum of 80 ft. The bottom of the bay on which the cable rests is sand or mud formation.

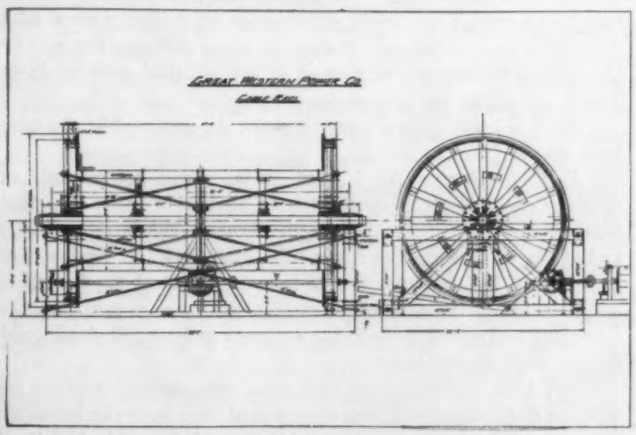
The operation of laying the cable was successfully accomplished on the afternoon of January 23d, 1912, although some difficulty was experienced in keeping the course on account of the incoming tide. The shore splices were made and the cable tested about midnight of the same day from the Oakland side.

In making the preliminary tests from the Oakland steam plant of the Great Western Power Company, after laying, a breakdown occurred at 11,500 volts. This immediately presented the interesting problem of locating, raising and repairing the fault, and no time was lost in getting ready for the work.

A Wheatstone bridge was first used in locating the trouble but the results were obviously unreliable and direct current at 250 volts was substituted by reading the current and potential drop.

The break was consequently located and the services of the cable repair outfit of the Pacific Telephone & Telegraph Company was enlisted to locate the cable and its fault. After towing the outfit approximately to the plotted location of the cable an anchor was cast overboard and the tug steamed away, slowly dragging the bottom, with the result that shortly the anchor was fouled and the cable hoisted out of the water and placed over a sheave 8 ft. in diameter which was suspended from the derrick on the barge. Once placed over the sheave, the barge was towed along in direction of the cable.

An alternating current of 100 amperes was maintained through the conductors and fault while underrunning and an exploring coil was used outside the armor. With current flowing, a distinct tone can be heard through a telephone receiver, the tone disappearing immediately on passing the fault. This method



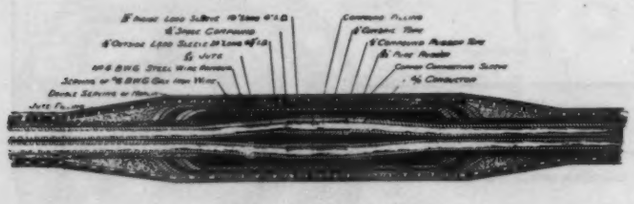
Cable Reel.

Cable Barge.

makes a definite and relatively quick means of locating trouble after the approximate location has been made by direct current tests for resistance. Accuracy of resistance tests is shown by results giving location within 5 ft. in 1500 and 100 ft. in case of the second fault, a distance of 7000 ft. from Pier No. 12.

Repairs were made in 24 hours' time, the cable thrown overboard and regular service commenced on January 29th. The two systems were paralleled and 1500 kilowatt hours per hour delivered in San Francisco the first day. This has been increased gradually to 3000 kilowatts which is about all that can be transferred without the aid of the regulating plant now on order.

The voltage compensating and regulating equipment for the Folsom street substation in San Francisco consists of a 575 k.v.a., 3-phase, auto transformer for boosting the potential from 9500 volts "Y" to 10,750 volts "Y" and a 690 k.v.a., 3-phase automatic, induction regulator with range of 1500 volts in either direction from 10,750.



Longitudinal Section of Splice
Bay Cable No. 1
Great Western Power Co
San Francisco Cal.

Cable Splice.

The auto transformer referred to above is also constructed with a winding suitable for raising the potential from 10,750 volts "Y" to 13,000 volts for use in feeding current back across the bay from San Francisco to Oakland in case of emergency.

The cable is protected on both ends by automatic oil switches and aluminum cell cable arresters.

On Feb. 20th at 6 p. m. the automatic switches on both ends of the cable tripped out and a test indicated a short on the cable. Upon testing by resistance method the fault was located 18,200 feet from the San Francisco end, or near the Western Pacific mole where the cable lays in 15 ft. of water at high tide. Immediately steps were again taken to find the trouble and after investigation it was found that the Western Pacific tug had lost its steerage way in low tide that evening and the propeller had cut the cable, causing an interruption.

The first two faults referred to above occurred at splices and were apparently due to slack armor, allowing a strain to come on the core during process of laying, resulting in a fracture of the lead sheath at the end of the sleeve.

The ease and certainty of locating and repairing faults lead us to consider the submarine cable a part of an ordinary underground system with the added advantage of water to put out the fire.

The success of this novel undertaking is due to the personal interest manifested by the employes engaged on the work, and especially to Messrs. Hanscom and Beardsley for their untiring efforts and co-operation in personally directing every phase thereof.

DISCUSSION.

The Transbay Cable of the Great Western Power Company.

H. W. Crozier (Chairman): We are certainly obliged to Mr. Naphtaly for his paper and description of laying their cable across San Francisco Bay. The meeting is open for discussion. I think probably you would like to ask a few questions while they are fresh in your minds, if Mr. Naphtaly will be so good as to answer them.

Question: What is the capacity of the cable from shore to shore?

S. L. Naphtaly: We figured with a rise in temperature of 150 degrees, the maximum we can get through with unity power factor is about 6200 kw.

J. E. Woodbridge: Was that first fault described by the speaker at a joint or in the cable?

S. L. Naphtaly: All the faults were at joints. It seems to be due to the slacking of the armor. The armor was wound on the cable as tightly as it could be when it left the factory. In order to make the joints we had to pare the armor off a certain number of feet, and then the armor was wrapped across the joint with the same pitch, you might say, as it was on the run of the cable; but we found that the armor slacked back on the cable, and it was almost impossible to hold it. We did not appreciate the importance of that until we had the burn-out.

J. E. Woodbridge: Did the lead open?

S. L. Naphtaly: Yes. The strain came on the lead, and resulted in fracture of lead at the end of sleeve. We have found all this trouble at the joints; that is to say, at he end of the lead sleeve.

A. G. Jones: How did you get the moisture out of the joints after the burn-out took place?

S. L. Naphtaly: The idea of impregnating the jute with insulating compound was to keep the moisture from running back, and we found little difficulty in cutting away sufficient cable to eliminate the moisture. The most we cut away was six feet, but we needed to take that up anyhow on account of the armor we had to get to replace the joint.

Mr. Clark: How much of a burn-out was there in the first failure?

S. L. Naphtaly: In the trouble due to the tug there was a very decided burn, while at the splice there was but little evidence of burning.

Question: Why was it considered neecssary to join the cable ashore before commencing the work of laying?

S. L. Naphtaly: We talked to everybody who had experience in this city and other places laying cable, and they all suggested the absolute necessity of joining the cable ashore on account of weather and tide conditions; but I am frank to say that the next cable we will join up on shipboard on account of the bending, and then it is a good deal easier to handle. You can go out there and anchor a barge, and get it overboard between tides; and even if you could not there is no difficulty on a calm day. If it is a rough day it may be more difficult, but not by any means impossible; in fact, it is the practical way to do it. Those are things we have to learn.

F. H. Varney: In anchoring there do you anchor the tugboat or the barge?

S. L. Naphtaly: As I tried to bring out, the method of catching the cable is to drag with an anchor in about the right location and hoist the cable on the barge. When the cable is picked up, it anchors the barge—the cable holds it against tide or wind. I believe other cables have been picked up, but there seems to be no difficulty about it. I saw a scow pick up one the other day and throw it back, but we seem to have telephone communication just the same.

H. Y. Hall: Was the use of a cable with varnish cambric insulation only considered, and what would have been the increased carrying capacity as compared with that of the cable installed?

S. L. Naphtaly: We did not go into that matter, because none of the manufacturers recommended a full cambric cable. The General Electric Company recommended a full rubber cable first; and they gradually, in order to meet the specifications, pulled down to a combination of Para rubber and cambric; but my recollection is that nobody figured on a full cambric insulated cable.

N. W. Reed: When you removed the armor outside the iron wire how did you join the ends together?

S. L. Naphtaly: When the armor was removed?

N. W. Reed: Yes. How did you make the joint in the armor?

S. L. Naphtaly: That was made by serving with a seizing around the end where the length of armor got back to the original size of the cable. When it passed the joint and got over to the original size of the cable there was a seizing put on there, and the armor was bent back over the seizing, and then the whole armor that was wound around was wrapped circularly with No. 6 wire.

N. W. Reed: There was no joint at all on the No. 6 wire?

S. L. Naphtaly: No.

N. A. Eckart: In the case of cutting the lead sheath under the water what precautions were taken in drying out?

S. L. Naphtaly: We found, as I mentioned before, the worst place, I think, was something in the neighborhood of six feet more than the piece necessary to cut off to get the armor. The test we made for moisture was taking the jute and putting it in boiling paraffine.

F. H. Varney: If you will remember your opening statement —the controlling factor in the cable was the size of the machine to armor the cable—did you consider with the manufacturers the possibility of building a special machine to armor a larger size cable? Isn't it a fact that the price of an armoring machine is not a great factor if you lay many cables of that size?

S. L. Naphtaly: We talked it over with the idea of getting a larger cable, but decided the advantages would not warrant the extra expense; and we also figured that if we had a cable over which we could really supply 5000 or 6000 kw., that was a good size unit for our conditions. We were satisfied to take something that they had. We did not want to go into more difficulty.

F. H. Varney: 5000 kw. is not a very great unit. For instance, to compare that with the size of a steam unit. I was wondering if you had figured at all on what it would cost to build a machine.

S. L. Naphtaly: We did not, but for our purpose we figured on a unit of 5,000 or 6,000 kw. doing what we cared to transmit. We figured that a certain number of those cables would take care of the amount of load that we wanted to transmit in the most economical way. We figured on three cables—two and a spare.

Question: About how long do you consider would be the average time to locate a burn-out and repair it?

S. L. Naphtaly: With the equipment which we expect to have I would say that they can be located, a joint made and put back in from twelve to fourteen hours. Of course I am inclined to think, from what we see of the thing, that if we get over this trouble we will have very little difficulty. Probably the fact that this tug caught us was because we haven't our cable crossing signs up, nor is our cable charted on the hydrographic maps. We have now got permission to put a proper sign up. The tug caught it with the propeller.

H. W. Crozier: Mr. Naphtaly has been very good to answer so many questions and now we would like to have some new ideas. It is suggested that perhaps Mr. Griswold, of the Pacific Telephone & Telegraph Company, might offer some information or some discussion as to experiences in repairing telephone cables in the same vicinity.

A. H. Griswold: Our cables are not power cables, but they are interesting to us. We have six or eight cables crossing San Francisco Bay, running from the old guttapercha cables to the more modern tri-core paper-covered cables; and the installation of those cables has been a very interesting problem to us.

There is a limit of depth at which cables can be laid. We have a cable in Puget Sound at a depth of about 120 fathoms, and the pressure is considerable at that depth, and it was anticipated that the cable would not be a success. That is a loose core paper insulated, lead covered, armored cable. The British Columbia Telephone Company recently laid a cable in the northern end of Puget Sound in about 140 fathoms. The cable was manufactured in England, and was a guttapercha cable, its selection being due to the fact that the manufacturers would not guarantee a lead covered cable under that pressure. It is an interesting fact in connection with guttapercha cables, that the greater the pressure the better the insulation, due of course to the pressure on the rubber closing the pores..

The design of telephone cables has progressed considerably in the last few years, and they are getting more and more difficult to handle. We require for transmission purposes a very low capacity cable to give us the proper efficiency, and the cable has a very loose core; in fact it is so delicate in a way that in the last cable, which we laid only a few weeks ago, we found that its characteristics had changed considerably in taking it off of the reel on which it was shipped and putting it on the reel of the cable barge; and the tests which we made after performing that operation were considerably different from the factory tests which were sent to us, and necessitated making some different arrangements in the splicing of the cable.

We splice the cables approximately in the same manner that Mr. Naphtaly has illustrated, with the exception that we use a single sheath instead of a double sheath. The armor is served in approximately the same manner. We have in nearly every case spliced our cables before placing them on the submarine cable reel, and have had no difficulty with the splices after being laid.

The control of a cable reel by any gear arrangement I believe is undesirable, because in laying a cable you must not have any strain upon it, and at the same time you must not allow enough slack to permit the cable to kink in any way. Consequently, if you have some adequate type of brake arrangement by which you can regulate the tension on the cable quickly and accurately, I believe better results can be obtained than by any gear arrangement, unless that gear arrangement be of a particularly good sort that would allow you to make very quick adjustments.

Our later types of cables are interesting because we have been able to operate phantoms over them. As many of you know, we can operate a third telephone circuit over two circuits; that is, the two circuits carry the third. We do that by what we call a duplex cable, specially and carefully designed. In the first place, considering only four wires, or a quad, as we call it, the four wires at the factory are first carefully measured as to characteristics, resistance, and as to length, being exactly of the same length. Then the four wires are insulated and twisted together with a definite twist, absolutely the same number of turns per foot throughout the entire length of the cable. This is necessary to get a uniform cable as far as the transmission is concerned. It was found that in the ordinary stock cable, in twisting a pair, frequently instead of the two wires twisting uniformly one wire would wrap around the other, and the length of one wire would be considerably greater than the length of the other. By this particular method we are able to get a cable with the wires uniform throughout, and by it we also hope to increase the capacity —by capacity I mean the number of telephone circuits per cable, by carrying phantom circuits through them under the bay.

The question was asked about a larger armoring machine.

Perhaps some of you do not quite realize the size of one of these cables after it is armored. It is about as large as your arm, and as stiff as a piece of iron of the same size; and if you had a cable much larger than that it would be very difficult indeed to handle. It would be hard to wind it on the reel, and I imagine that it would not be much of a success.
such a way that it would not be much of a success.

D. P. Fullerton: I think Mr. Griswold has covered the point, but we have had a varied experience in cable laying. I believe that outside of the Western Union Company we probably had the first cable across the San Francisco Bay. The telephone company's first cable was laid in the early eighties, and consisted of a single wire rubber-covered, and armored of course. Later on our cables developed, and for a great many years a 5 pair, and 7 pair, 14 and 16 gauge were our standard. In 1902 we laid our first paper cable. In those days we figured the average life of the rubber covered cable would be probably six or seven years. As a matter of fact some of them are in service today that we laid as far back as 1896 or 1897. In some of them certain pairs are broken down and are unfit for use except on very short lines, but others are giving good service.

In 1902 the first paper insulated cable was laid. It was a 28-pair. Since that time we have gradually improved the type of cable until now the last cable—the latest type—which was laid a few weeks ago, is an 85 pair, and built up of 13 gauge, 16 gauge and 19 gauge cables. We have at the present time six cables between here and Goat Island; nine between Goat Island and Long Wharf; four across the Straits of Carquinez and three across the Heads.

In the early days of the paper cable a break was quite a serious thing for us, but today we do not find it so. We are pretty well equipped to take care of our troubles, and on a break we find time is the salvation of our cable.—Further we find that the manufacturers have aided us greatly in the building up of the cables by the manner in which the paper is stowed away. We find now on a break that the water seldom goes back from each side of the break over 60 or 70 feet, which we consider a good factor in cable construction. We find the swelling of the paper compresses whatever air may be in the cable, which will in time prevent the water from going back more than 60 or 70 feet from the break.

We have had in the last year or two few breaks that forced us to abandon any cable. We found lately that it is an easy matter to take up any cable that is damaged and replace it and put it in good service. That includes the cables across the Golden Gate. For a great many years a cable that showed bad across the Heads was abandoned and a new cable laid. At this time it is an easy matter to get up that cable and relay it.

Our cables, the latest type, will approach in size the cable that Mr. Naphtaly just described. The last cable we laid I think weighed about 14 pounds or 15 pounds to the foot, and was close to 3½ in. in diameter. We have two cables across the Heads that are double armored. The first armor over the lead cable on the jute is No. 4 steel wire, and outside of that, laid in the opposite direction, is an armor of No. 2 mill steel wire. The double armor we found really necessary at the Heads on account of the swift currents and the rocky bottom. We are satisfied that in places our cables are suspended between rocks and over chasms, and that the swing of the cable in the tide wears it away and eventually causes a break.

We recently found that one of our cables was beginning to show trouble. When we took it up we found that the armor, considering the length of time that the cable had been down, was in good condition; probably 25 per cent being eaten away; but where the trouble occurred the entire steel armor of the cable had been eaten away for the space of not over two feet and each wire tapered down to a point. There was a separation of an inch or two between the ends of the wire, and our only conclusion was that the cable had probably laid across some copper part of the old "City of Chester," sunk a few years ago, which possibly started some action.

We were very glad to assist Mr. Naphtaly in the handling of his cable, and I am glad to see that he has reverted to the idea of laying his cable in sections. For a cable of that size we would recommend always that it be laid in sections, and the splice made on board the vessel. We find no trouble whatever in making our repairs; and while we have had no occasion to lay a cable in sections, we have in case of trouble cut off one portion of the cable, the defective portion—sealed up the end of the other and dropped it overboard, and afterwards picked it up and relaid our cable.

Our greatest faith however in laying the cable is in the personality of the men in charge of the actual laying and the actual location of the faults, and that is where our success comes in in making repairs to our cables.

The cost of cable laying we estimate at an average of about 30 cents a foot; that is the actual laying of the cable.

There is one thing which I do not think Mr. Naphtaly did in his cable which we practice. Where the cable is spliced and the sheath put over, the lead sheath, where it is wiped at the ends, the wiping metal is tapered down so when the armor is relaid over there you don't have to splice gradually; and it enables you to lay on your armor practically as tight over the splice as was put on the cable originally, and we have had no trouble with splices in the last six or seven years to my knowledge. Our greatest trouble is the Stockton schooners who insist on picking us up with the anchor.

Referring to the question as to anchorage the barge in making repairs, with the mush-room type of anchor you have no trouble in following the cable. The mushroom will permit your barge to swing in any direction and will not foul any cable.

C. F. Elwell: Knowing that the members would be interested in what had been done in Europe in this connection I wrote over to the Compagnie de l'Industrie Electrique et Mechanique in Geneva, and received the following reply:

"We have already had occasion to study the use of submarine cables for a service tension of 150,000 volts direct current and carrying capacity of 150 amperes.

"So far as the cable itself was concerned, the question had been completely solved previously, and it was more particularly on the junction boxes that the tests were made.

"These tests have been absolutely satisfactory and we do not see any difficulty at all in the realization of the junction boxes, for those which were built for the experiments stood up to a test of 300,000 volts direct current after being intentionally submitted to mechanical effects powerful enough to tend to deform them.

"As for the cable itself employed by us it had a core of copper .116 square inch in section, which signifies a density of 1290 amperes per square inch. This density is not high as proved by the long tests on the underground cable of the Moutiers-Lyons transmission.

"The insulation consisted of a sufficient thickness of cellulose impregnated with a special material; over the insulation two seamless lead sheaths put on hot with a hydraulic press and separated from each other by means of a layer of thick pitch; over the last two impregnated papers, a layer of cordage, an armoring of No. 9 B. & S. steel wire and over all a winding of tarred hemp.

"Constructed for a service tension of 150,000 volts, the different pieces of the cable were all subjected to a tension of 300,000 volts for a quarter of an hour before shipment.

"The insulation was about 800 megohms per mile at 10 degrees C.

"The non-accessible junction boxes were made of lead sleeves.

"The European price of the cable insulated for 150,000 volts and constructed to carry 150 amperes with junction boxes was $3540.00 a mile, laying not included."

ELEMENTS OF TURBINE TESTING.[1]

BY ROBERT SIBLEY.

We come now to the important consideration of methods used in the commercial testing of turbines. It seems to be thorough standard practice, so far as Coast conditions are concerned, that turbines purchased from the large manufacturing concerns should live up to certain definite guarantees under strict rules of performance. In addition to the question of heat regulation, the most important feature of a turbine test is that of economy in operation.

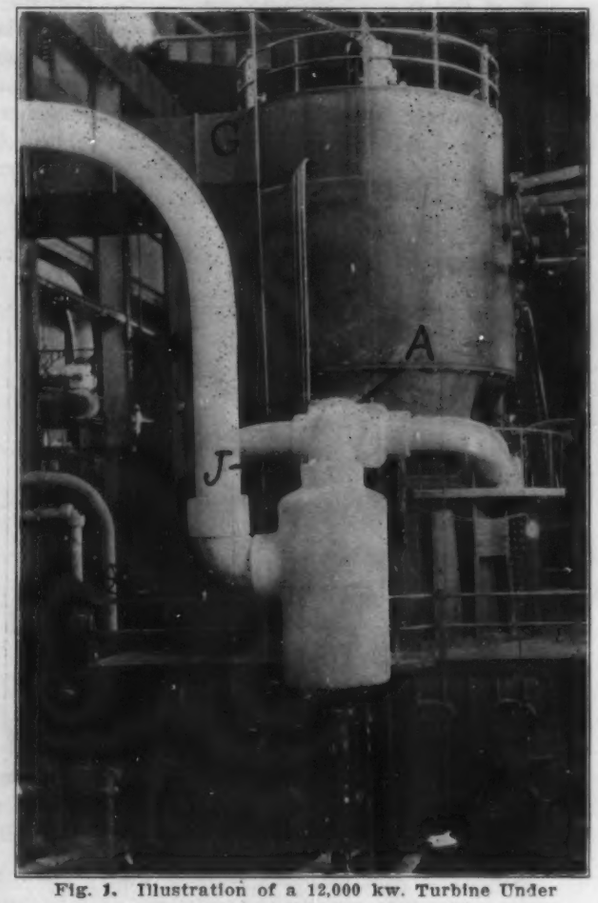


Fig. 1. Illustration of a 12,000 kw. Turbine Under Test.

In Fig. 1 we have a picture of a 12,000 kw. Curtis turbine. Let us assume that this turbine is sold under conditions of guarantee for three separate load variations. For full load of 12,000 kilowatt output the steam consumption should not exceed 15 lb. per kilowatt hour. For 10,000 kilowatt output the steam consumption should not exceed 14.5 per kilowatt hour and for 7500 kilowatts the steam consumption should not exceed 15 lb. per kilowatt hour. Thus, it is seen that the most efficient operation is to be under a load of 10,000 kilowatts. The turbine under standard conditions is to operate at 200 lb. absolute and 28½ in. vacuum.

It is interesting and instructive to enter into details of the method used in performing a test of these proportions. In the first place let us consider the temperature determinations necessary, which are as follows:

1. Superheat.
   a. Main temperature.
   b. Stem temperature.
2. Condensate.
   a. Outlet No. 1.
   b. Outlet No. 2.
3. Circulating Water.
   a. Inlet.
   b. Outlet No. 1.
   c. Outlet No. 2.
4. Air Draft.
5. Barometers.
   a. Temperature of Vacuum Barometer No. 1.
   b. Temperature of Vacuum Barometer No. 2.
   c. Temperature of Atmospheric Barometer.

Referring now to the list of temperature measurements above mentioned, let us analyze them more closely. In Fig. 1 at A we see the inlet steam main through which live steam is just entering the turbine. At this point the two thermometers used in the determination of the superheat are placed. One thermometer is placed in the oil well which dips in the flow of live steam. The other thermometer is bound with this superheat thermometer but its bulb does not dip in the oil well, thus measuring only the stem temperature of the thermometer used for determining the superheat. We are thereby enabled to make the proper correction for the main superheat thermometer, since its bulb and outer portion are at different temperatures and consequently need to be corrected. The amount of superheat is of course determined by reading the pressure gauge denoting the pressure of the entering steam. The gauge must be properly standardized. By reference to steam tables, the temperature of saturated steam for this pressure is determined and the difference between this temperature and the corrected temperature above noted for the superheat is the proper determination for superheat.

The temperature of the condensate, which is the temperature of the water just formed by the condensed steam from the turbine, is measured at two different points or at as many different points as there may be, through which the water is forced by the wet vacuum pump into the hot well. In the practical illustration shown in Fig. 1 two such places are to be found shown at B and C in the diagram

In the case of the circulating water used to condense the steam utilized by the turbine, the water enters through a large main directly beneath the turbine and then divides outwardly through two separate mains. Hence to accurately determine the temperatures maintained by the in-going and out-going circulating waters, three temperatures are necessary. One is called the inlet temperature, the thermometer for which is placed in the supply pipe just as it enters the turbine condenser, and the others are called outlet thermometers Nos. 1 and 2 and are located similarly at the point where the circulating waters leave the condenser. No quantitative measurements are as a rule taken for the circulating water, the general capacity of the pumps are, however, noted. The all important point is to observe the difference in temperature of the in-going and out-going circulating water and should this come above an allowable amount either

[1]This article comprises the Twenty-third Lecture of a series appearing in these columns entitled "Primer of Applied Thermodynamics."

the condenser itself is working improperly or else an insufficient quantity of the circulating water is being forced through the condenser pipe.

At G, in Fig. 1, a thermometer is placed to keep a general tab upon the temperature of the in-going circulating air for the turbine generator. This thermometer is not absolutely necessary but adds to interesting data in connection with the test. Thermometers are also placed upon all mercurial barometers used in the test. For the turbine shown in Fig. 1 three sets of thermometers are used. At H thermometer No. 1 is placed since a vacuum barometer is here located. This is shown in Fig. 1 and a closer view in

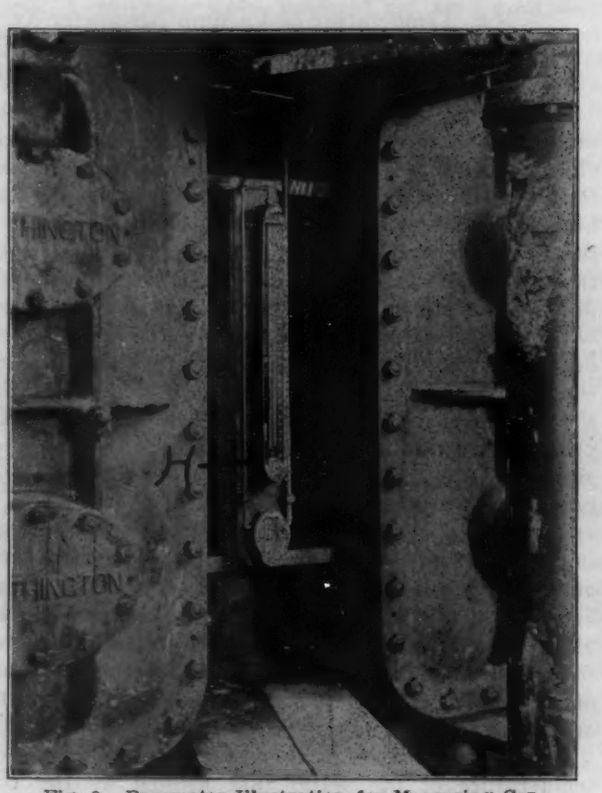


Fig. 2. Barometer Illustration for Measuring Condenser Vacuum.

Fig. 2. Diametrically opposite in the rear of the turbine, thermometer No. 2 is similarly placed to determine the temperature of the vacuum barometer there located. Thermometer No. 3 is placed at a convenient place near the turbine under test. This is used to determine the atmospheric pressure at all times during the test.

The following pressures are determined which are necessary for the gathering of complete data:

1. Pressure gauge for steam entering the turbine.
2. Pressure gauge for steam in first stage of the turbine.
3. Vacuum Pressure.
   a. Barometer No. 1.
   b. Barometer No. 2.
4. Atmospheric pressure barometer No. 1.

A carefully calebrated steam gauge is placed at J in Fig. 1 which is used for the determination of the pressure of the steam entering the turbine above referred to. Also at J is located a standardized pressure gauge, showing the pressure of the steam in the first stage of expansion in the turbine. Although not necessary, it is interesting and instructive to install additional steam gauges for the determination of steam in the remaining stages of expansion, for careful data of this sort is of much useful application and indicates any developments in the way of uneconomic operation of the turbine.

As the most accurate method of measuring any pressure is by means of the mercurial barometer, there should be installed at H in Fig. 1 such a barometer. Another similar barometer should be placed diametrically in the rear of the turbine. These two mercurial barometers will measure in inches of mercurial height the difference in pressure between the outside air and the vacuum within. Now if we have an atmospheric barometer situated nearby, which measures the absolute pressure of atmosphere in inches of mercury, we can, by taking into account the temperature of the mercury, compute accurately the vacuum obtained in the condenser.

By careful installation and reading of the differ-

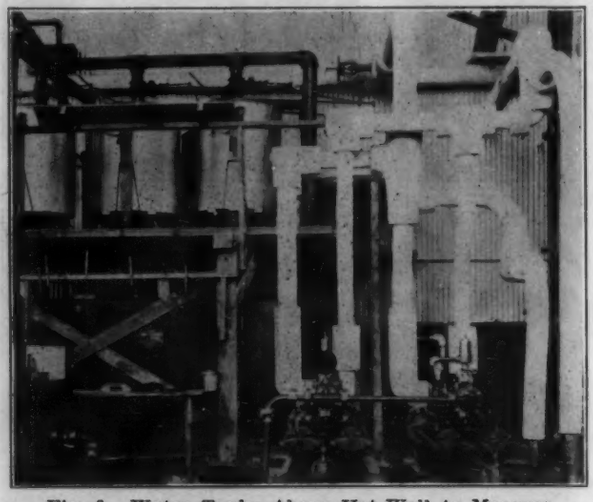


Fig. 3. Water Tanks Above Hot-Well to Measure Water From Turbine.

ent temperature and pressure devices above outlined the testing engineer can gather sufficient data to compute the water consumption, provided he has a careful and accurate method of measuring the condensed water.

There are two methods of measuring the condensed water—one is by constructing tanks of definite volume and keeping tab on the number of tankfuls dumped into the hot well, the second method is that of actually weighing each tank with its water. So far as accuracy is concerned, the second method is so satisfactory in every respect we shall only consider this process.

In Fig. 3 is shown three tanks which are placed upon scales carefully calibrated and standardized. These tanks are installed immediately above the hot well or placed where make-up water is formed. All of the water coming from the condenser is taken through pipes shown above the tanks in Fig. 3 and dumped in turn into them. As soon as one tank is filled, it is carefully weighed and this weight is then tabulated. By subtracting the weight of the empty tank, which is each time carefully weighed, from this gross weight

just tabulated, we arrive at the proper weight of the water per tank. The time of the emptying of each tank is carefully noted. At the end of a test of four or more hours the complete amount of water thus weighed is totalled which enables us to compute the weight of steam utilized in the turbine.

We come next to the measurement of the electrical output. Three separate methods are usually taken to determine this. The instruments should be carefully compared with some standard which itself has been calibrated at the United States Bureau of Standards and again calibrated as accurately as is possible when set up for the taking of the test. The instruments most preferred are those of the so-called indicating type, but for many practical purposes those of the carefully standardized integrating type are useful and accurate.

Fig. 4. Typical Arrangement of Meters for Measuring Electrical Output of Turbine.

When integrating watthour meters are used, as a rule, five are installed—two for the so-called two-watthour meter method, and three for the measuring of the power output in each phase. In addition to this an indicating watthour meter is placed across one phase so that the load under which the turbine is operated may at any moment be determined.

In addition to the alternating current measurement, the input of the direct current electrical energy used in the excitation of the generator fields is carefully measured. If now we divide the total amount of water condensed per hour by the known amount of power generated per hour we can determine at once the steam consumption per kilowatt hour for the turbine under test.

A SEA WEED INSULATOR.

In connection with the recent endeavors to use the kelps of the Pacific Coast as a source for potash it is of interest to note that an insulating material made from ordinary seaweed has been produced by an English chemist, Mr. John S. Campbell. Recent tests carried out at the Westminster Electrical Testing Laboratories are said to have proved it to possess all the ordinary merits of an insulator besides having an unusually high resistance. Immersed in water the test showed a resistance of 30,000,000 megohm-centimeters. Samples 1 mm thick withstood from 9000 volts to 16,000 volts alternating current before being punctured.

CRUDE OIL FROST PROTECTION.

To the Editor:—As to the number of pounds of crude oil or distillate which is required per acre per year to safeguard an orchard, I may say that this is a very difficult question to answer. Last year, 1911, was the worst year in the history of this district, as regards frosts, and some orchards required as much as 2000 pounds of oil per acre per season. The average, however, did not run so high.

Taking the acre as a unit, we estimate that in the average orchard, with the trees in full bearing, there are about 500,000 cubic ft. of air to be heated. In going over my experimental data, I have found that it will require approximately 1 B.t.u. per cubic foot per hour to maintain the temperature one degree above that of the surrounding atmosphere. In other words, 500,000 B.t.u. are expended per degree F rise in temperature per acre. This rise in temperature is secured by the burning of about 30 gallons of crude oil or distillate. Now, the average distillate or crude oil contains approximately 18,000 B.t.u., but, of course, the full efficiency of the oil is never secured in burning as we are compelled to burn it in a crude orchard heater. From the above data, you can easily estimate how much electrical energy will be necessary to maintain the same temperature conditions. Under average conditions, a rise of 50 degrees F. or more must be secured to keep the fruit above the danger point. We have instances where a 10 degree rise was necessary.

You will see by the above that in maintaining temperatures in an orchard requires the expenditure of an enormous amount of energy. If electrical energy is desired in the form of heat you will see that to cover an area of 1000 acres would require an enormous plant to carry the peak load.

[1]No doubt, you have in mind the matter of protecting from frost by the use of electrical energy in a different form than by the use of heating appliances. You probably have in mind the use of large fans to keep the air in motion, or perhaps high tension discharges. Some work along these lines has been done, but I think that it is of little practical importance. Going back to the matter of using electrical energy in the form of heat, aside from the impracticable part of using costly heating appliances, the amount of power necessary would put it out of the range of possibility, or rather practicability. By referring to the figures on the acre you will easily see that to raise the temperature 1 degree F. would require practically 200 h.p. of mechanical energy, not even considering transmission losses or anything else.

Although my work is pathological and entomological, I am also an electrical engineer, having had some practice in the building and designing of power plants and electrical apparatus. However, engineering is only an avocation with me and I work with it for the mental amusement I now find in it.

P. J .O'GARA,

Pathologist in Charge and Special Meteorological Observer, U. S. Weather Bureau, Medford, Ore.

[1]See Journal of Electricity, Power and Gas, March 2, 1912, Editorial Page.

PRACTICAL ADVERTISING FOR PUBLIC SERVICE CORPORATIONS.

BY J. W. SWAREN.

While the advertising of a public service corporation is largely different from other types of advertising in its appeal,, the peculiar conditions surrounding it, and the nicety with which it elucidates, when properly done, several of the most discussed questions of advertising, makes it deserving of more study than is usually given, especially by those who are most vitally affected by its results.

Strictly speaking, public service corporations include local servitors as the telephone, gas or electric supply, street car and similar utilities. More generally speaking, long distance telephone, telegraph and transportation and other companies are included, and each of those of the first named class of utilities, fade insensibly into those of broader import.

Until recent years these companies have relied, where they thought the public worthy of enlightenment on any point, upon the wiles of the press agent, or in some more notorious instances on the control of a subsidized press. The manager of the utility corporation regarded the publisher as a hold-up man of the purest breed, while the publisher reciprocated by considering the utility company legitimate prey. I regret to say some companies still follow this idea. But with modern tendencies, the more sagacious managers of these corporations are turning to display columns and some of the most consistent campaigns ever conducted in the advertising field have been, and are being carried on by corporations of this class. The effect created has been far reaching civicly, morally and mentally.

Three important ultimate results stand before the advertising manager of a public service corporation.

First: Moulding of a favorable public opinion.

Second: Prevention of inimicable legislation.

Third: Increased sale of the utility under consideration.

Every piece of copy, it matters not the particular aim in view, must be prepared with these three essentials in mind; and phrasing, illustrations, and ornamentation, must be consistent with this main frame. To accomplish these three ends, at times at contrary purposes to each other, requires a certain degree of finesse and a deep insight into the primordal instincts of human nature. Time forbids touching on these requirements, interesting though they be, but I hope in a later paper to describe some of the means commonly employed to increase the efficiency of advertising copy, and particularly those used to influence the unconscious inclinations of the mind.

In the main, public service advertising is general publicity work. It is doubtful if any term has been more discussed and cussed and less understood than that old scape goat, "General Publicity." Rightly approached and properly handled, no form of advertising is capable of greater development, and, though of a subtle nature, of direct, tangible and measurable results. But generally speaking, the man who cries "General Publicity" the loudest, understands it the least, largely because he has not taken the pains to investigate its fundamental laws.

Moulding public opinion is not done by the beat of tom-toms or the blare of a brass band, but it is that constant entering into the life of the home, until the impression it is desired to create unconsciously becomes a second nature to the public at large.

Taking up concrete problems we will examine the last essential mentioned above "Increased Sale of the Utility." First: Advertising and sales department must co-operate in the fullest sense. Neither must be allowed to dominate. The advertising is the pioneer, figuratively speaking, building trails into the wilderness, here and there opening up a rich mine of business and permeating the entire field as the leaven of the yeast permeates the loaf.

The selling department follows after, and corresponding to the agricultural interests following the pioneer, covers the entire field until the maximum production of business results. In public service corporation work, this analogy can be carried a step farther.

The farmer first entering into new country skims the high spots and robs the soil. Press of competition, (here competition is used to cover in one term all of the pressure brought to bear on a public service corporation) forces him to more intensive cultivation, and the sales manager of the public service corporation must inaugurate a fine tooth comb campaign of the territory under his jurisdiction.

In passing, this paper is based on an assumption that any public service corporation inaugurating an extensive campaign for business has established its physical conditions as solidly as circumstance surrounding its operation, will permit. Only good goods can be advertised successfully, and this applies with double importance to the public service corporations. After this, enthusiasm in the advertising, and zeal in the selling, but consistency between the two and a level headed manager to balance and utilize every constructive move.

Take an electric appliance campaign, as an example. The toaster can be used for one series of effort. Put a force of solicitors, using sample toasters if desired, with instructions to visit and sell every house connected with the system. Instead of having the prestige that normally is associated with the representative of an important business, the solicitor will be received as an ordinary canvasser, and half, yes, two-thirds of his energy and possibly his time will be spent in getting a footing with his prospective buyer; all weight and prestige of an important industry being willfully cast away.

Precede these men with a well balanced campaign of clear cut reason why copy, continuing through the actual canvass, and unconsciously, perhaps in many cases consciously, his call will be expected, little or none of his energy being expended in placing himself on a proper footing with the prospective buyer.

It is not probable that a direct mention of the fact will be made, but unconsciously through the mind of the prospective buyer will run this thought "Oh, that's one of those electric toasters that makes possible those dainty breakfasts I saw planned the other morning in the Tribune." But here is where many electric service companies have failed, and here is where you, should it come within your province,

to deal within this class of advertising, can avoid a pitfall.

A few moments ago I used the term, "reason why copy" and by this I do not mean the hammer and tong arguments, the irrefutable figures that are ordinarily associated with this term. By "reason why copy" I mean copy that will show the consumer that it is to the advantage of his pleasurable benefit, as well as his pocket-book, to make a further use of the available utilities. This copy must cover three points.

First, it must appeal to their sensible pleasures.

Second, it must make a presentation within financial reach of the utility user.

Third, it must be tied in with local civic interest.

A large portion of the utility advertising, and particularly electric utility advertising, has been prepared by the appliance manufacturers. A common example of the toaster under consideration shows it on a breakfast table, dominating the scene, two insipid figures possibly, a few words crying the toaster and some more or less senseless patter about the joys of using the "Jim Crack" toaster, (of course no other will fill the bill) but not one word of the service nor the institution behind it, a clear ignoring of our first and second essentials in public service advertising.

Yet this is a class of stuff to which many of the largest utility companies have signed their names, and is their ideal of new business getting.

Why not this?

In the upper left hand corner a pen and ink sketch of a water power plant set in the canyon, with the water rushing down the mountain side, a pair of wires strung across the page and at the lower right hand corner a breakfast table. "This Power Will Bring You a Dainty Breakfast," will be the headline; fill in with a short talk on the use of electricity in toasters, percolators and egg boilers, with particular reference to the toaster. In a conspicuous place at the optical center of the space if the balance permits, print an appetizing breakfast menu, and its cost in terms of current. A few closing words about the demonstration campaign and a clear cut signature of the company. Have this conform with the names on your wagons and letterheads, in fact wherever the name of your company appears, have it uniform, a symbol of your activities.

Another theme would show the steam reserve plant and the heading "To Make Your Breakfast Certain." A few words calling attention to this link in your chain of service and a different menu of course. But the various links in the service could furnish copy, each with a fresh view point, for every day in the year. It is not a question of where to get ideas, but a question of what to use. Now then analyze this copy in the light of the three basic requirements.

First, the moulding of a favorable public opinion. This feature of showing the great pains that have been taken to perfect every detail in the chain of service offered cannot help but create a favorable impression on the public, and will unconsciously create a friendly feeling toward the utility company.

Second, the prevention of inimicable legislation. The human nature at heart is selfish, and every user of electric energy, or any other utility who actually knows something of the conditions under which he is served, will resent any regulation that will tend to unfavorably affect his relations with this service. At first glance this might seem an argument that could be turned into a favorable argument in an agitation for lower rates. Should this result, a plain statement in the display columns if you please, and not press agency of the company, showing exactly what the results of decreased rates would mean, would go far towards counterating any such agitation, in fact, you will have established the firmest foundation for combating such a campaign.

As a by remark on public service corporations in general, permit me to say that seldom does the public object to the price, if reasonable, it pays for any service, provided the service is of the highest quality, and this returns to a point I made previously, that before any public service corporation can start a successful campaign, it must be in adequate physical condition.

It is an actual fact that even the heaviest campaigns of this type will bring comparatively few replies to the office, but if you ever have the opportunity of checking the cost of sales in two similar towns, one where the selling campaign is preceded and accompanied by advertising, the other without this assistance, you will find the cost per appliance in the unpreceded campaign from two to five times greater than in the supported campaign, including the cost of the advertising.

But one important essential is co-operation, between engineering and sales on one side, between sales and advertising on the other. With a management honest enough to put their proposition square before the people, the maximum development of electrical service will result.

ARRANGEMENTS FOR N. E. L. A. EXHIBITS AT SEATTLE.

The exhibition committee for the thirty-fifth convention of the National Electric Light Association, to be held at Seattle, Wash., June 10 to 13, has announced the arrangements for the exhibits. J. C. McQuiston, Pittsburg, Pa., is chairman of this committee. The convention headquarters will be in the City Armory and the exhibits will be placed in the Drill Hall, which measures about 200 by 100 feet. One end of the hall is cut off by a double partition, forming a spacious meeting hall. The exhibit hall has been laid out in such a way as to provide 70 booths of good proportions, with an aggregate floor area of 8,150 square feet. Regulation prices for space will include platforms, signs, decorations and unlimited telephone service. Two chairs will be furnished free and additional furniture may be secured at schedule rates. Through the courtesy of the Seattle Electric Company, current for lighting and for the operation of exhibits will be furnished without charge. This current will be single-phase, 60-cycle, 117-234 volts.

To reduce the expense of shipping exhibits from the East the committee is making arrangements for grouping and reshipping material from Chicago in carload lots.

ENGINEERING SPECIFICATIONS.

BY R. G. McDONALD.

A short while ago the writer had occasion to read a set of specifications covering the hydraulic equipment for a municipal plant. The reading suggested the idea of starting a discussion along these lines.

The particular set, referred to above, were not extraordinary in any particular, but represented the average. They had the fingermarks of having been either largely copied from some book or were cut down from some other job to partially fit the conditions of the present work. The principal objection, however, was that there were at least two clauses which were impossible of fulfillment, and that they practically designed the equipment and at the same time required the builder to make stringent guarantees.

In what follows, the writer feels that there is some good logic. This, because he once tried the thing out by issuing two sets of plans and specifications covering a large hydroelectric and irrigation system. One set was written to exactly meet the requirements of the work, taking into account the working conditions from the contractor's point of view. The other was made arbitrary and considered only the viewpoint of the critical engineer. They were minute in their detail, called not only for a certain class of finished work, but stated methods of procedure. They designed equipment, then required results thereon. The final result was that there was a large difference in the bids submitted. It is needless to say that the contracts were let according to the first named scheme, with the glorious result that a job was secured that is equal to any.

It is the writer's notion that a good set of specifications should meet the following conditions and requirements.

They should not be standard, "cut and dried," but be written especially for each piece of work, based on a careful study of the requirements of each job.

They should be so drawn that the contractor has liberty to use his ingenuity and skill, so long as the class of work is not impaired.

They should be clear as to their intent and meaning, avoiding all superficial matter.

They may call for tests and quantities of materials, although it is better to furnish as many of the important materials as possible.

In case they cover machinery it is best to call for results of rigid tests, allowing the manufacturer the privilege of doing his own designing. There are few plant designing engineers who are competent to take the responsibility of designing the machinery proper. Therefore, they always make the manufacturer responsible for results as well. The engineer referred to above is in fact a correlator of machinery and should leave the other operations to those who are specialists in their lines.

Allow only reputable concerns to submit bids and put them under bond to guarantee the performance of apparatus, etc., for a period of time consistent with good judgment.

Prejudice should not influence the wording to admit or preclude certain equipment materials.

WIRING COSTS.

The great uncertainties regarding costs of installation are largely responsible for the present hazardous reputation of the electrical contracting business. The Sterling Electrical Manufacturing Company has compiled much valuable data on costs in installing the Mazda lighting system. The following is gleaned from their recent excellent publication entitled from Post-hole to Lights On.

Cost of Carrying One Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

52 35 ft. poles assembled and set 100 ft. apart, $7.50 each.	$390.00
Stringing 3 wires one mile	12.50
3 miles of No. 6 weatherproof copper wire (or 3 1 mile wires) 15,840 ft., or 1760 lb., at 14½c. per lb.	255.20
	$657.70

Cost of Carrying Three-Fourths Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

40 35 ft. poles assembled and set 100 ft. apart, $7.50 each.	$300.00
Stringing 3 wires ¾ mile (3960 ft.)	10.00
2¼ miles of No. 6 weatherproof copper wire (or 3¾ miles wires) 11,880 ft., or 1320 lbs., at 14½c. per lb.	191.40
	$501.40

Cost of Carrying One-Half Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 10% Drop.

26 35 ft. poles assembled and set 100 ft. apart, $7.50 each.	$195.00
Stringing 3 wires ½ mile (2640 ft.)	8.00
1½ miles of No. 6 weatherproof copper wire (or 3 ½ mile wires) 7920 ft., or 880 lbs., at 14½c per lb.	127.60
	$330.60

Cost of Carrying One-Fourth Mile of Wire From Source of Supply to Distributing Station in Town.
High Tension 2200 Volts (3 Wire) 5% Drop.

13 35 ft. poles assembled and set 100 ft. apart, $7.50 each.	$ 97.50
Stringing 3 wires ¼ mile (1320 feet)	7.00
¼ miles of No. 6 weatherproof copper wire (or 3 ¼ mile wires) 3960 feet, or 440 lbs., at 14½c. per lb.	63.80
	$168.30

Note.—The No. 6 wire specified in above primaries will carry 50 amp. one mile at 2200 volts with about 10% line loss and when transformed to suit commercial, power and street loads will supply 500 to 1000 amp. or about 100 kw. to the secondaries, depending on their voltage.

Cost of Constructing One Street Lighting Circuit Over One Mile of Streets From Distributing Station in Town.
1100 Volt Series Circuit 6.6 Amp. 10% Drop.

35 25 ft. poles assembled and set 150 ft. apart, $3.50 each.	$122.50
Stringing 1 wire one mile	7.50
1 mile of No. 6 weatherproof copper wire (1 1-mile wire) 5280 ft., or 587 lbs. at 14½c. per lb.	85.11
	$215.11

Note.—The above circuit will accommodate a load of from 6 to 7 kw., or 60 to 70 80 c.p. Mazda street lamps or 80 to 90 60 c.p. or 120 to 130 40 c.p., or an assortment of the above lamps up to the kw. capacity or voltage of the line. The lamps must all have the same amp. draw regardless of their voltage, to work in series.

No. 6 wire may be used for a series circuit 1½ miles long, the cost of constructing same to be figured on same basis as the mile circuit given above; such a circuit would require about 53 poles with the additional cost of a half mile of wire and a proportionate increase in the cost of stringing the wire. The capacity of this circuit would be less than the mile circuit on account of the extra drop due to the extra length of circuit, accommodating perhaps 50 to 60 80 c.p. Mazda lamps or their equivalent representing a load of about 5 to 6 kw.

Alundum is an artificial refractory made by purifying and fusing bauxite in the electric furnace. It has a melting point of over 2000 degrees C. and is used in the manufacture of fire-brick, crucibles, muffles, etc. Experiments at the plant of the Norton Company of Worcester, Mass., showed that while alundum fire-brick outlasted silica brick as a roof for electric steel furnaces, its higher cost did not warrant its use. For laboratory apparatus alundum is eminently satisfactory.

THE ELECTRICAL DEVELOPMENT LEAGUE.

Ding, ding—dong, dong,
Goodwin hit the bell
With an "ad" seven blocks long:
"Prices shot to hell."

From the moment the curtain rose at the noon meeting in San Francisco at Tait's Cafe, March 12, 1912, by the proposal of T. E. Bibbins and others to start, if possible, a loud grievance commotion somewhere in the harmonious gathering until the closing of this scenic effect by the proposal of W. S. Goodwin to place an "ad" on Market street with the above insertion, the meeting was full of energy and ginger. Even the recent achievements of J. A. Vandegrift at golf were momentarily forgotten.

The different events followed in interesting alignment. Geo. C. Holberton, president of the league, opened the program by announcing that the Pacific Gas & Electric Company would hereafter cease making service charges and there would undoubtedly follow a large increase in the purchasing of electrical fixtures and novelties in which the entire electrical fraternity would share.

J. W. Redpath, a member of the publicity committee, then made an interesting report. Near each plate at the table was found a paper napkin upon which was neatly and attractively printed a copy of the peoples' electrical page now appearing in the Cleveland Plain Dealer. In addition, artistic sketches, depicting electrical uses in the home, were passed around as suggestions for the running of an electrical page in the San Francisco daily press. These suggestions were characteristic of forceful advertising. An item could be found here which at once caught the eye, and, again, something was found to excite the curiosity and, finally, the reader was unconsciously lead into reading the entire page which bubbled over with little educative points in household applications of electricity—from curling irons to bungalows, the householders' attention was held fast.

The postal card idea was also the recipient of hearty endorsement. It is proposed to have a certain day similar to the "California Invitation Day" held some time back, in which thousands of cards were at that time mailed to all parts of the world, setting up the attractive features of the great "poppy State." In the electrical postal card scheme, it is proposed to send cards on a certain date to all consumers of electricity in and about San Francisco. Upon these cards are to be printed points of human interest in the electrical game—water-falls, rivers, interior of power plants—anything and everything to arouse interest in consumption of electrical energy.

Interesting discussion then followed. Considerable sums of money were indicated as being ready to start the project under way. E. B. Strong urged that an immediate starting of this publicity campaign on the part of local electrical men could not help but bring out hearty support of the eastern manufacturing companies. Holberton, Bibbins, Carter, Hanbridge, Levy and Goodwin all took part in the discussion. Each had views differing from the other, but throughout the entire meeting it was evident to all listeners that each had at heart the proposing of the best means to harmonize and unify electrical interests and a deep felt spirit of co-operation in order to make the electrical industry profitable for all concerned. In fact Col. Carter, president of one of the leading jobbing houses, stated that he felt the electrical page would mean so much to his house that he would subscribe very heavily, if all the other jobbers present staid out. This statement brought forth humorous applause, and all caught the forceful argument intended; namely, that the electrical publicity campaign would mean much to all, and especially to those standing ready to boost the proposition financially.

The entire publicity proposition appeared in such a favorable light it was finally moved and carried that the publicity committee in conjunction with the president of the league bring to the next meeting a detailed scheme for a daily electrical page to run in the San Francisco press for a period of three months.

The meeting then adjourned and each man present felt a stronger and more wholesome spirit was even thus early being engendered by the electrical Development League, all of which augurs well for its continued existence and prosperity.

NEW PLAN FOR INCANDESCENT LAMP SALES.

On March 1st there was inaugurated a new plan of distributing incandescent lamps, in order to conform to certain legal requirements as enunciated in a recent decision of a U. S. District Court.

Under this new plan no sale is made except to a consumer or user of lamps, the distribution from the manufacturer to the consumer being accomplished by agents or distributors of which there are two classes equivalent to jobbers and dealers.

The manufacturer does not sell his lamps to these distributors, but appoints them as his agents and allows each of them a compensation for handling the business.

The lamps remain the property of the manufacturer until paid for and it is thus possible to maintain a uniform sales price on the part of all handling lamps covered by patents.

The lamps will be sold without restriction as to re-sale prices. The properties of the constituent companies of the National Electric Lamp Company have been transferred to the General Electric Company, and those companies will hereafter conduct their business as a part of the General Electric Company.

CO-OPERATIVE TELEPHONE SYSTEM IN MEXICO.

A concession has been granted to a number of merchants in Monterey for the operation of a telephone system in that city on the co-operative plan. The plan of the originators of the idea is that each subscriber should own his telephone, and there will be not less than 4000 subscribers who will also be stockholders in the new company. The telephone lines will be operated by the underground cable system.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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An Appeal to Western Engineers

Thus far the concerted action of western engineers in assisting the getting together of the greatest engineering congress of history at the Panama-Pacific Exposition in 1915, may be likened to the modern steam turbine when relieved of all the load and merely "floating on the line." Western engineers have been in thorough synchronism with the movement, having assisted in maintaining a maximum power-factor, and have even aided in preventing undue surges of a destructive nature, but so far as the actual carrying of the load is concerned, the recording instruments fail to indicate any appreciable deflection.

The congress of engineers at St. Louis was most helpful. The civil engineers in particlar had a most notable gathering. A splendid array of papers was given to the world, but when the American Society of Civil Engineers began to foot up the bills, it was found necessary to dig up from their national treasury the sum of $38,000.

The Journal some weeks back, published a copy of the invitation which has been sent to all the national engineering societies. This invitation is held in the most favorable light. Official representatives of nearly all the great engineering societies have visited San Francisco during recent months. These men feel, and justly too, that the engineers of the Coast ought to stand ready and willing to contribute a portion of a $50,000 guarantee to meet possible contingencies. In a word, they feel that the coast engineers should pledge themselves to the extent of $10,000 to insure the success of the undertaking, before the national societies put their official sanction and guarantee upon the project.

This appeal is now being mailed to the prominent engineers of the Coast. No obstacle has ever been allowed in the west to prevent her onward progress and ultimate triumph. Loyalty, open-heartedness, generosity—synonyms of the West—surely these characteristics will predominate in this urgent cause!

San Francisco Bay Cable Crossing

The whole world was interested and amused last fall when three daring young mermaids swam across the Golden Gate at San Francisco, which had hitherto baffled all attempts on the part of feminine ambitions. The city of San Francisco has now another maritime feat to its honor, but, this time, it comes not from the athletic prowess of its citizens, but is an outcome of the keen competition of the great power companies of central California.

An aerial or submarine crossing of San Francisco Bay has been thought of and discussed for years. Indeed, long since would there have been an aerial power crossing over the Golden Gate, which would have made the crossing at Carquinez straits—the present greatest project of its kind in the world—insignificant in comparison, had not the War Department, ever jealous to guard against a weakening of national strategic points, frowned upon the idea.

It is interesting to review in mind the methods used by the various hydroelectric companies in trans-

mitting their power into San Francisco. The forerunners of the Pacific Gas & Electric Company, after being denied by the War Department the privilege of an aerial crossing over the Golden Gate, decided to bring their power around by the southern end of the bay, thus shortening the distance of a subsidiary line into the growing city of San Jose. The San Francisco & Sierra, a recent installation of high order, preferred crossing over the bay immediately to the south of Dumbarton Point. This was accomplished by steel towers placed 1600 ft. apart. The foundations for these towers were prepared by driving piles and filling with concrete. Though higher towers were necessitated, yet a remarkably sound construction, having every appearance of permanency and durability, was effected. In addition, too, the standard uniform make of tower was not varied from.

Now comes the Great Western Power Company, cutting the Gordian Knot, as it were, and effecting a short and efficient crossing by submarine cables. One of the most striking features of the installation is the ease with which faults are detected and the accuracy with which they are located.

The Telephone Problem

The problem of absorption of the independent telephone systems on the Coast by the older and more powerful company each day becomes more acute. Seattle, Tacoma, Portland, Los Angeles and San Francisco are being shaken to the quick with the agitation.

At first sight it would seem of but passing interest to the citizens of the various municipalities affected. In fact, the prospect of having to pay for but one telephone in the future, thus doing away with the duplication nuisance, appeals so strongly to the merchant that often he heralds with joy any combination whereby this seemingly heavy burden may be dispensed with in the future. But—ah—how careful we should be to see to it that the burden is in reality taken away forever, and not placed upon us in another form!

The proposition is simply this: An enormous quantity of reduplication work has been brought about by the independent telephone companies in the great cities of the West. Under no possible economic system could these institutions be absorbed into the older company and yet make possible the economic utilization of the entire expensive reduplication work. We must consider that the people, having undertaken the responsibility of regulating the great public service corporations, are morally bound to see to it that the corporations get fair play. If this combination is allowed, unless a proper protest is now made, we shall be duty-bound to allow this combined company to earn an interest throughout eternity on the combined investment, even though the major portion will not materially aid in effecting economic telephone service. In a word, if there must be a loss, let the ones who gamboled on the original reduplication now shoulder the fortunes of the god of chance.

In the study of astronomy we are told that the only way we can get a clear idea of the roundness of the earth, and a comprehensive idea as to how the earth rotates about the sun instead of the sun about the earth, is for us to picture ourselves out in space away from our surroundings. And so it is in the affairs of life, the only way we can deal out absolute justice to our fellows is for us to journey outward into space and soar above the hurly burly, jealousies, dislikes, selfishness and avarice of human life.

In the case of the telephone combination, it is not right, because an unwise investment may have been made on the part of the original promoters, that we should guarantee an interest on this mistake throughout eternity, thus forcing upon our children's children an unjust and unfair burden. The entire affair should be carefully reviewed by the respective public service commissions and whatever seems just to allow in the way of added efficiency by taking over the new equipment should receive the stamp of approval—not one cent more, nor one cent less.

The Proposed Closing of the Mint

It is, indeed, true that we live in an economic age—an age where every excuse for the existence of an industry must be carefully weighed in a balance and if found wanting from an economic point of view, the enterprise should be cut forever from our national life.

The eastern states grew and waxed strong from their natural inheritance in forests, water powers, oil and coal fields, and yet many of these self-same states are now loud in speaking against allowing our western states the same privilege. In fact many of the current proposals for development of natural resources in the west would hobble our growth by delaying our development a generation or two, and the worst of these proposals is to put into the national treasury funds derived from these western resources. These should unquestionably be immediately put back into the section whence they came.

And now comes the proposition to close down our mint—the pride of the west for practically half a century. The San Francisco mint has been a fitting tribute of a proud nation to the mineral wealth produced in the West. Not for one minute, however, should sentiment be allowed to outweigh the inexorable decree of the Darwinian Law—the survival of the fittest.

The great Rocky Mountain range, like the British channel, stands forever a natural barrier between the east and the west. No matter how delicate may be our financial clockwork, this isolation will be felt. When the greatest fire of history swept over San Francisco, destroying practically every private enterprise, the mint, the customs house, and the postoffice were saved. Why? Because a great government stood by to protect. Talk not to the citizens of the coast that private enterprise could possibly afford the same substantial guarantee in the coinage of our moneys—an act which is in a sense the very heart throbbing of our nation.

Our very life as a commercial factor depends upon the security of our monetary matters,

Let us then see to it that this security is not impaired even though we pay a premium for this insurance. Briefly, but emphatically, the San Francisco mint must not be closed.

PERSONALS.

H. R. Noack, president of Pierson, Roeding & Co., is at Los Angeles.

H. R. Johnson, who has light and power interests in Montana, is at San Francisco from Butte.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is at Los Angeles visiting the branch office.

R. D. Holabird, president of the Holabird-Reynolds Company, has returned to San Francisco after visiting Seattle on business.

F. A. Richards, manager of the car department of Pierson, Roeding & Co., is in the Pacific Northwest on business for the firm.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company of Milwaukee, is at Seattle after spending a week at San Francisco.

H. L. Bleeker, vice-president of the Washington Water Power Company, has returned to Spokane from a visit to Southern California.

Milton E. Wise, formerly with the Street Railways Advertising Company, is now advertising manager for the Great Western Power Company.

L. P. Gates, superintendent of the car department of the Pacific Electric line of the Southern Pacific Company at Los Angeles, is at San Francisco.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard and Supply Company, has returned to San Francisco after a trip to the Chicago office.

C. G. Young, a prominent consulting engineer, is at San Francisco on a tour of the Pacific Coast investigating various properties for eastern banking interests.

F. A. Somers, of the Westinghouse Electric and Manufacturing Company's district agency, has returned to San Francisco after visiting Southern California.

The Stone & Webster Construction Company has opened a purchasing agency which is in charge of F. T. Barry at 415-417 Rialto Building, San Francisco.

J. D. Ross, electrical engineer of the Seattle municipal light and power plant, is now chairman of the Seattle Section of the American Institute of Electrical Engineers.

W. W. S. Butler, vice-president and general manager of the Western States Gas and Electric Company, with headquarters at Stockton, is a recent arrival at San Francisco.

C. M. Clark, who is the principal owner of the Portland Railway, Light & Power Company, is at Portland on his annual inspection trip, after spending some time in Southern California.

F. N. Baylies, manager of the Chicago office of the Aluminum Company of America, is spending a few days at San Francisco on his way homeward after enjoying a vacation at Los Angeles.

E. W. Rollins of the firm of E. H. Rollins & Sons, of Boston, who are heavily interested in the financing of the Great Western Power Company, is visiting the firm's San Francisco office after having spent the winter in Southern California.

H. E. Grant has resigned as sales agent for the British Columbia Electric Railway Company, Ltd., at Vancouver, B. C., after five years' service. Mr. Grant has received offers from several firms but will travel in Southern California for a time before establishing new business connections.

Gano Dunn, the president of the American Institute of Electrical Engineers, will arrive at San Francisco early in April, en route to the Pacific Coast Convention at Portland, which opens April 16th. He will visit the San Francisco office of J. G. White & Co., of which firm he is the vice-president.

Rudolph W. Van Norden, consulting electrical and hydraulic engineer, has returned to San Francisco from Los Angeles.

Cal. E. Goodrich of Minneapolis, who is president of the Twin City Rapid Transit Company, which furnishes local and interurban electric railway service for Minneapolis and St. Paul, Minn., is at San Francisco.

Henry C. Hazzard has resigned as chief of the division of light, heat and power with the New York Public Service Commission to assume a similar position with the Railroad Commission of California.

H. A. Lardner, manager of J. G. White & Co.'s San Francisco office, will go to Portland to meet A. S. Crane, the company's hydraulic engineer, who will arrive there from New York next Monday. They will spend some days in engineering investigations for the Portland Railway, Light and Power Company.

S. L. Shuffleton, who has charge of the Stone & Webster Construction Company's engineering work in California, has opened a large office in Fresno in connection with the construction of the Big Creek power plant of the Pacific Light & Power Corporation. A considerable force of hydraulic engineers, draftsmen, etc., will be engaged on the above work.

J. B. Rannie, who has been for a long time connected with the British Columbia Electric Railway Company, Ltd., latterly as traffic manager for the Vancouver lines, has been promoted to the post of general traffic agent. Jas. Hilton, formerly connected with the Montreal Street Railway, succeeds Mr. Rannie in charge of the Vancouver branch of the company's system.

Charles T. Phillips, consulting engineer, is at Roseville, Cal., preparing to design a municipal substation, street-lighting system and a distributing system for commercial light and power. The city is now purchasing electric power from the Great Western Power Company for 1.5 cents a kilowatt-hour and will also retail the same in future. Funds have been raised by a bond issue.

Ralph L. Phelps, Pacific Coast manager for the Safety Insulated Wire and Cable Company, is at Sacramento superintending the laying of a very heavy submarine cable in the Sacramento River in connection with the operation of the Northern Electric Railway Company's new drawbridge. The cable is heavily armored and has a cross section of 1,500,000 circular mils. It is the largest capacity direct current cable made.

Walter Arnstein, vice-president of the Oakland, Antioch & Eastern Railway Company, has returned to San Francisco from the East after completing the financing for the extension to Sacramento. It is understood that the contract has just been closed for this final section of the road amounting to fifty miles. J. G. White & Co. have the engineering supervising. J. M. McCampbell of that firm, who is supervising the work on the tunnel, will also have charge of the new railroad work which will be commenced in the near future.

L. G. Robinson, who has been for the past three years associated as assistant with the engineering forces of the British Columbia Electric Railway Company, Ltd., has resigned his post and will enter upon practice as private consulting engineer in Vancouver, B. C. Mr. Robinson was formerly connected with the Shawnigan Power Company and Ontario Power Company in Eastern Canada and among his early work in British Columbia acted as assistant to Mr. Le Baron in his plan for the reclamation of the lands about Sumas Lake.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

Hale Bros. are receiving bids for a five-story building on the corner of Fifth and Market streets. The ground plan is 137½ by 165 feet. Reid Bros. are the architects.

Don't forget the annual meeting of the National Electrical Contractors' Association in Denver, Colo., July 17-18-19, 1912. Your friends will want to see you there. Round trip fare, $55.

The electric wiring for the new Sharon estate building on Jessie, New Montgomery and Stevenson streets, has been awarded to the Pacific Fire Extinguisher Company for $7800.

Bids are being taken for the electric wiring on a large hotel on Bush street and Grant avenue which, will amount to $7000; also one on Taylor and Geary streets which will amount to $12,000.

The Pacific Gas & Electric Company have announced their intentions of giving free service connections in the future on all their lines. This move will cause a large saving on the part of the consumers, and all contractors should show their appreciation of this move. While many contractors feel that the company should make these connections free, let us take advantage of the present move and induce people to connect to the lines, thus making business for ourselves.

SUBSCRIPTIONS FOR INTERNATIONAL ENGINEERING CONGRESS.

As a factor in the consideration of ways and means for the organization and management of an International Engineering Congress in connection with the Panama-Pacific Exposition in San Francisco in 1915, which question is now before the governing bodies of the principal National Engineering Societies in the East, it is proposed to raise among the engineers of the Pacific Coast a guarantee fund of $10,000.

It is confidently expected that the sums to be realized by membership fees, by direct appropriation from the National societies or in such other ways as they may determine upon, will serve in very large measure to defray all necessary expenses of the Congress coming under the general heads of (1) Publication, (2) General Publicity, (3) Expenses of Local Committee.

The above proposed fund of $10,000 is however intended to serve as a guarantee to this extent against any shortage in such funds, and to show to the various governing boards that the engineering profession of the Pacific Coast is willing to become responsible for such a share in the necessary expenses of the Congress should the need arise.

There are good grounds for the belief that an assurance of this character coming from the engineers of the Pacific Coast will be a strong factor in determining the attitude of the National Governing Boards toward the proposed Congress.

Subscriptions to this fund are hereby asked under the following conditions.

(1) Subscriptions are not to become effective until a sum equal to or exceeding $10,000 is pledged among the engineers of the Pacific Coast.

(2) Subscriptions are not to become effective until some general plan of organization and management for an Eastneering Congress shall have been approved and adopted by a sufficient number of the governing bodies of the National Engineering Societies, with such further provision for financial backing as shall insure the general success of the movement.

(3) In case the desired local fund of $10,000 is over subscribed, pro rata amounts will be allotted to the various subscribers.

(4) At the close of the Congress and after the payment of all expenses against which the local guarantee fund might be expected to apply, any unexpected balance, with accrued interest, will be returned pro rata to the subscribers.

The plan of subscription will call for payments: one-quarter when a Congress is assured, and three-quarters each January 1, 1913, 1914, 1915.

Prof. Wm. F. Durand of Stanford University is chairman of this committee.

SEATTLE ENGINEERS' CLUB ELECTS.

The Engineers' Club of Seattle, which was recently organized, met at a banquet at the Seattle hotel, this week, when the following executive officers were elected: Amos Slater, president; C. W. Willette, vice-president; R. D. Sterling, secretary. The board of directors elected at the same time were W. D. Allen, D. C. Botting, State Inspector of Mines; George W. Evans, P. M. Hale, Ernest B. Hussey, F. A. Hill, James A. Kelly, James H. Linton and P. E. Wright.

TRADE NOTES.

The Pacific Northwest Traction Company, Bellingham, Washington, has ordered an equipment of No. 304 motors and type HL controls from the Westinghouse Electric and Manufacturing Company.

Geo. A. Dow, in the course of a European trip, has obtained the American rights for the manufacture of the Willans-Diesel engine from Willans & Robinson. The Dow-Willans-Diesel Engine Co. will erect a manufacturing plant at Alameda, Cal., adjoining the present plant of the Geo. E. Dow Pumping Engine Company.

The Balfour-Guthrie Cement Company at Bellingham, Wash., whose plant is now rapidly nearing completion, has just concluded an arrangement with the Whatcom County Railway & Light Company for power to operate the plant. Some of this power will come from the Nooksack River plant, while a portion will be purchased from the British Columbia plant at Chilliwack.

The Pacific Portland Cement Company contemplate the installation of the Cottrell dust treating system in the plant at Cement, Cal. A motor generator set consisting of a three-phase motor and single-phase generator will supply single-phase alternating current to a bank of step-up transformers connected to rectifiers which will furnish high voltage direct current for the dust-precipitating system.

George J. Henry, 737 Rialto Bldg., S. F., is designing two impulse water wheels for two 150-h.p. hydroelectric units for the Eastern Oregon Light and Power Company. The new generating sets will be added to the present plant, situated on the eastern slope of the Cascade Mountains, which furnishes municipal and commercial lights and power for mining purposes at Baker, Ore. A five-mile wood-stave pipe line conducts water to the plant.

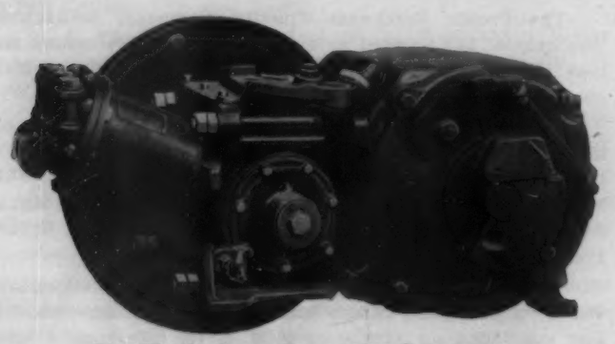
The Pacific Gas and Electric Company has purchased the holdings of the South San Francisco Light and Power Company, including a substation and distributing system. The South San Francisco district of the Pacific Gas and Electric Company has just been formed, in which will be included all of the power lines between Milbrae and the San Francisco county line. Frank P. Edwards, the manager of the old company, will be retained as district manager by the new management.

J. Coughlin & Sons of Vancouver have accepted a contract from the British Columbia Electric Railway Company, Ltd., for raising the high tension wires of the company, crossing the bridge over the Fraser River at New Westminster. At present the wires are 200 feet above the water at the "sag" point and the contractors will increase this height to 225 feet. The work is being done at the request of the New Westminster authorities in the interests of navigation on the river.

INDUSTRIAL

THE WESTINGHOUSE COMBINATION DYNAMOTOR COMPRESSOR.

The Westinghouse combination dynamotor-compressor described herewith is a device for use on 1200 and 1500-volt direct current motor cars and locomotives; it performs the functions of both dynamotor and compressor furnishing half voltage for the operation of the control and lighting circuits, and in addition drives the air compressor when necessary. The dynamotor is connected between trolley and ground, and operates continuously. When the air reservoir pressure falls below a certain predetermined value, the compressor is automatically connected to the dynamotor by a clutch. When the compressor raises the air pressure to a



The Westinghouse Dynamotor-Compressor.

predetermined maximum value, the clutch is automatically disconnected and the compressor stops.

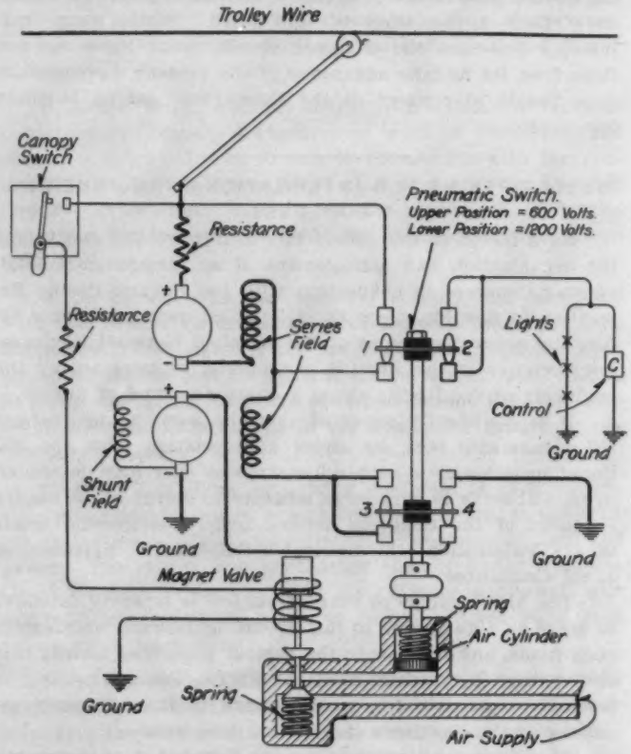
The usual arrangement for 1200 and 1500 volt equipments consists of: (A) a high or low voltage motor for operating the compressor, and (B) a continuously running dynamotor for supplying current at half voltage (600 to 750 volts) for lights and control, and for the low voltage compressor motor, if such is used. The Westinghouse dynamotor-compressor performs the duties for which the two machines were formerly required and as a result, there is a saving of about 900 pounds in the weight of the equipment, and there are fewer parts and only one machine to maintain.

In sections where the trolley voltages is 600 or 750, the dynamotor connections are changed by throwing a canopy switch, so that the dynamotor becomes a compressor motor operating on one winding on half voltages and at normal speed thus driving the air compressor at normal speed. Full air pressure is therefore assured on all interurban and city sections. The straight 1200 volt motor-driven compressors operate at only half speed when on the half voltage sections of a road, and are often incapable of delivering sufficient air to provide for the frequent city stops.

The methods used for lubricating the machine are ingenious and effective. Splash lubrication is used for the compressor cylinders, pinion, gear, clutch and the bearing adjacent to the clutch. The oiling is continuous. The crank case is maintained about half full of oil and the compressor cranks, in splashing through, break up the oil into small drops. Some of it is thrown through a hole in the gear case and onto the gear. The gear carries it over to the pinion which throws a portion on the clutch and a portion on the waste in a lubrication pocket over the adjacent armature shaft bearing. The waste is saturated and the surplus drains back through a duct to the crank case to be used again. The armature shaft bearing adjacent to the commutator is lubricated by means of an oil-well-and-waste arrangement similar to that used on Westinghouse railway motors and therefore only filtered oil is fed to the shaft.

The dynamotor has two separate armature windings on the same core each connected to a commutator. When the dynamotor is connected across 1200 or 1500 volts, the two windings are in series, so that each takes one-half of the trolley voltage. Each armature winding is in series with a field winding. A shunt field winding is connected across the leads of the low voltage armature to maintain the speed approximately constant. The connections are shown in the illustration.

The compressors are of the D-2-L and the D-3-L types and are made by the Westinghouse Air Brake Company, Wilmerding, Pa. They are similar in general design to the compressors that this company has so successfully manufactured many



Connections of Dynamotor and Change-Over Switch.

years for electric railway service. One excellent feature is the placing of the cylinders at an angle, which insures effective splash lubrication and their thorough draining.

A modified type N air pressure governor of the general design that has long been successful in electric railway service operated, indirectly, the dynamotor clutch. There is no electric switch on the governor as an air valve is used instead.

An improved form of the multiple disc clutch, that has given most excellent service on automobiles, is used. It is simple, effective and reliable. When the air-pressure governor, set for some predetermined pressure, acts, it opens a valve admitting air to cylinder adjacent to the clutch. A piston in this cylinder operates against a heavy spring in such a way as to disengage the clutch. When the tank pressure reach a minimum value, the air in the cylinder is automatically released by the governor, the spring closes the clutch and the compressor starts. The clutch is engaged when there is no air pressure so that the reservoir can always be filled.

A switch for changing the dynamotor connections from those for 1500 to those for 750 volts (or from 1200 to 600 volts)

is provided when desired. It simultaneously changes the control and lighting circuit connections from the dynamotor terminals to the trolley. This change-over switch is pneumatically operated and controlled by a canopy switch located in the cab. It consists of a single magnet valve and a pneumatic cylinder similar to those used on Westinghouse switch groups. It carries a double pair of contacts which establish the proper dynamotor and auxiliary circuit connections. Normally, this switch is held in the high-voltage position by a powerful spring. But, when desired, it can be held in low-voltage position by the admission of air to the pneumatic cylinder. In case of a failure of either air or electric power, the switch automatically returns to the high voltage position —the safe one at all times.

NEW TRANSFORMER OIL DRYER AND PURIFIER.

With the extremely high voltages common to the present day transmission systems it is absolutely necessary that the transformer oil be maintained free from moisture and foreign substances which reduce the dielectric strength and render the transformer unable to withstand the heavy stresses it is subjected to. The General Electric Company has developed a transformer oil dryer and purfier which effectively removes water, solid matter, slime, etc., from transformer oil. As a result of exhaustive tests it has been demonstrated that the best method for removing these substances from oil consists in forcing it under high pressure through several layers of dry blotting paper. All solid matter is caught by the first layer of paper while the water is retained in the paper by capillary attraction as the attraction between the paper and water is greater than that between the paper and oil.

For the utilization of this principle specially designed filter presses of several sizes and capacities have been developed, each comprising a special form of press mounted on a base frame of I beams and provided with pump, motor, piping, drip pan and auxiliary devices. The essential portions of the filter consist of a series of alternate flat cast iron plates and frames, the blotting paper being placed between them, and the whole clamped tightly by means of a large screw and lever at one end. Both plates and frames have large cored holes in the lower corners, serving as inlet and outlet for the oil.

The surface of the plates, except for a ½-in. rim round the edge, is grooved or corrugated both vertically and horizontally, on both sides, forming the checkered or so-called "pyramid" surface, which supports the paper and forms channels communicating with the outlet at the corners. This form of surface is more efficient than a single set of corrugations or the use of perforated metal. The oil enters at the lower left-hand corner of the filter, passes through a series of cored holes (A) in the plates and frames and punched holes in the blotting paper and enters and fills in parallel the chambers formed by the frames and plates. It then passes through the blotting paper, along the grooves of the pyramid surface, to the lower right-hand corner of the plate, and then through a series of small holes drilled from the surface of each plate to a cored passageway (B), similar to the inlet.

Since the plates and frames are very thin, and are all connected so that the oil circulates in parallel, large filtering surface and great capacity is obtained in small space; the 12-in. size, containing twenty chambers with forty sets of papers and five layers each, has a total length over the active portion of only 22½ in., yet will filter at the rate of 15 to 30 gals. of oil per minute.

A rotary gear or multistage centrifugal pump is furnished, depending on the size of the filter and the individual requirements of each case. The rotary gear, positive pressure pumps used for the smaller size of filters are extremely simple and compact and are geared to the motors to run at reduced speed. The multistage centrifugal pump of the 12-in. size was especially developed for this purpose.

Any style of motor may be used, geared to the rotary gear positive pressure pumps, or direct connected to the centrifugal pumps.

An electric drying oven has been developed especially for drying the paper. It is substantially built of sheet steel, is provided with thermometer and regulating rheostat and with heating units designed for 110 or 220 volts.

The interior is provided with suspension rods on which the paper may be strung so that it hangs in a vertical position.

The paper should always be saturated with dry oil immediately on removal from the oven, and before it has cooled, as exposure to normal air for a few minutes is sufficient to neutralize the effect of drying.

In addition to its use in purifying transformer oil it is also applied to the treatment of many other liquids as well as heavy viscous compounds, the latter preferably being slightly heated before treatment to reduce their viscosity.

Outfits are now in constant use for the purification of the following materials:

Transformer oil of all kinds, crude petroleum for oil fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating press-board and wood, cylinder oil used in certain types of electrical apparatus, and viscous insulating compounds.

NEW CATALOGUES.

Seager Engine Works of Lansing, Mich., have published an attractive catalog on the various features of Olds gasoline engines.

Circular 1165, Westinghouse Fan Motors 1912, is an attractive publication, with a grey and gold cover, just issued by the Westinghouse Electric & Manufacturing Company, describing the new line of fans for the ensuing season.

The U. S. Indestructible Gasket Company of New York has just published a new catalogue in form of seven loose leaflets on high pressure sheet packing, corrugated metal gaskets, manhole gaskets, multiple disc valves, etc.

Westinghouse Metallic Flame Arc Headlight is the title of a small folder No. 4202 illustrating and describing this new type of railway illuminant recently placed on the market by the Westinghouse Electric & Manufacturing Company.

"Street Railway Lamps," is the title of Bulletin 18, recently issued by the engineering department of the National Electric Lamp Association. This bulletin gives complete data on gem and carbon lamps for street railway use, and should be of considerable interest to those connected in any way with street railway work.

The Wheeler Condensing & Engineering Company, of Carteret, N. J., whose Pacific Coast representatives are Chas. C. Moore & Company, have issued a valuable hand book of "Steam Tables for Condenser Work," giving pressures below atmosphere expressed in inches of mercury referred to a 30 in. barometer and a discussion of the uses of the mercury column.

The engineering department of the National Electric Lamp Association has recently issued Bulletin No. 19, illustrating and describing the electric luminous radiator, and calling attention to the many ways in which it may be made a convenience in the home. The non-luminous type of radiator is mentioned and comparisons are drawn between the two kinds. A table of data on luminous radiator lamps in regard to size, wattage, voltage, etc., is inserted.

TRADE NOTES.

The Westinghouse Electric and Manufacturing Company has sold the Southern Pacific Company 20 quadruple car equipments for use on its electric railway lines in Alameda County. Westinghouse Type "H. L." controllers will be used.

NEWS NOTES

INCORPORATIONS.

LEWISTOWN, MONT.—The Lewistown Electric & Power Company has been incorporated with capitalization of $1,000,000. Wilford J. Johnson heads the company.

LOS ANGELES, CAL.—Lorbeer Electric Supply Company; capital, $25,000; directors, Arthur W. Cleaver, Edward G. Lorbeer, James Irvine and Earl G. Alexander.

TURLOCK, CAL.—A company has been incorporated to be known as the Turlock Gas Company, with a capital stock of $75,000. The company will build and operate a gas plant in this city.

IMPERIAL, CAL.—The Valley Telephone Company has filed articles of incorporation with Holtville as the principal place of business; capital $25,000. O. N. Shaw, J. W. Hart and P. C. Curtis are directors.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed with the County Clerk by the Mount Shasta Power Corporation, capitalized for $10,000,000. It is the purpose of the corporation to develop power on the Pitt River in Shasta county and to distribute and sell electric power and water.

SAN DIEGO, CAL.—The Captain Mutual Water Company has filed articles of incorporation for the purpose of securing a supply of water for irrigation purposes from the watershed of the San Diego River. The capital stock is $90,000. W. R. Andrews, M. B. Christopher and L. Mansur are directors. The office of the company will be located at La Mesa.

SACRAMENTO, CAL.—Articles of incorporation for the San Francisco-Oakland Terminal Power Company, capitalized at $30,000,000 have been filed. The company is to deal in water supply for power purposes, gas, supply, etc. The principal offices will be in San Francisco, and the directors named are F. O. Harrington, L. L. Dunne, Lloyd L. Jackson, L. Abbott, Nat Schmulowitz and C. Cosner, all of San Francisco.

ILLUMINATION.

NAPA, CAL.—A franchise for operation in this city was granted to the Great Western Power Company.

ALAMEDA, CAL.—The City Council has adopted the preliminary bond resolution calling for a $200,000 issue of bonds for electricity, police and fire department improvements, including a new building for the electric light plant and the moving of the plant from the south end of Park street to the corporation yard at the north end of Grand street, fronting on Oakland harbor.

PITTSBURG, CAL.—Van E. Britton, president and chief stockholder in the new Contra Costa Gas Company, organized to supply gas to Martinez, Antioch, Pittsburg and Concord, has obtained an option on a large tract of land in Pittsburg. Work will begin on the $200,000 plant as soon as the weather will permit. Cottages will be erected for the workmen of the plant, and the laying of the pipe lines will begin in a few days.

VANCOUVER, B. C.—The Vancouver Gas Company has recently placed in service its No. 5 gas holder in connection with its system for the British Columbia metropolis. The equipment is a four lift telescopic holder in steel tank and was constructed and erected by Ashmore, Benson, Pease & Company of Stockton-On-Tees, England. The holder is 150 ft. in diameter and the guide towers are 160 feet in height, the capacity of the holder being two million cubic feet of gas. The water tank, which has a capacity of 3,500,000 gallons, is 32 ft. 6 in. in height, and each of the telescopic lifts is 31 ft. 6 in high. The steel plates used range from ⅞ to ⅜ in., about 1000 tons being used in the work. The holder is located in the Grandview section of the city where the company owns a block on which is already located a gas holder of smaller size.

TRANSMISSION.

SEATTLE, WASH.—W. J. Haycox and associates have been granted a 20-year franchise for a power plant.

LOON LAKE, WASH.—John Kulzer, owner of the electric light systems at Springdale and Valley, expects to start work soon on an extension of his system to Loon Lake.

FLORENCE, ORE.—G. G. Bushman has applied for a power and light franchise here. An election will be held March 11 to determine whether the city wants electric light or not.

TULARE, CAL.—C. Rogers has been granted the right to operate a system of masts and poles and wires for the purpose of transmitting electricity for heating, lighting and power purposes in this city.

FLORENCE, ORE.—Geo. M. Miller and James Miller and Joaquin Miller, the poet, have a water power site above Mapleton. They intend establishing a plant and furnishing power and light to nearby towns, including Florence.

PORT TOWNSEND, WASH.—The Key City Light & Power Company will erect a substation of concrete and steel for transforming the high voltage current furnished by the Olympia Power Company. An outlay of between $6000 and $7000 will be made. M. T. Crawford is in charge.

TRANSPORTATION.

SONORA, CAL.—The Sierra & San Francisco Power Company is having repairs made to its flume system at Forebay. The company is planning to run an electric line from the Phoenix lake plant to a point above Strawberry, where the new dam is to be constructed this season.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has submitted to the Vancouver civic authorities plans for the extension of its system by the construction of a line on Nanaimo street from Hastings street to Broadway, a distance of over a mile. The plans call for the construction of the line during the present year.

PETALUMA, CAL.—Twenty-five thousand dollars, which is half of the bonus needed for the construction of the new electric railway north of this city through the Two Rock and Bloomfield valleys, was subscribed at a meeting held this week. The property owners are enthusiastic over the proposed new road and there will be very little trouble in raising the $50,000 needed. The new line will probably go to the coast.

STOCKTON, CAL.—That the Stockton Electric Street Railroad plans to extend its lines in the near future is indicated by the statement that eight carloads of 75-pound T rails are en route here from the Colorado Iron & Fuel Company in Denver and that 3000 tons of additional rails and more cars have been ordered. Three extensions have been discussed—one reaching into Fair Oaks, another for the extension of the El Dorado street line to Oak Park, forming a belt line, and the third out Oak street to the western limits of the city, skirting to the north and re-entering over Poplar street.

SANTA ROSA, CAL.—Surveyors are at work between here and Petaluma surveying a route that will connect Santa Rosa and Petaluma and contiguous territory much more quickly than at present by electricity. It is believed that the extension will be built directly the data is procured. This is the first step toward connecting this county and Marin county with a direct electric railroad to the bay of San Francisco. Another arrangement is contemplated by other capital whereby the Bloomfiled section of this county shall be exploited by electric railroad.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will start the erection of a machine and carshop building, on its grounds between East Seventeenth street and the grounds of the Southern Pacific Company, Center and Mall streets, as soon as the plans have been approved. It will be the third structure erected on these grounds by the street railway company. The two buildings erected by the company, each cover a block and will be used for the construction of the cars. They are one-story buildings, of brick construction and well lighted. The roofs are supported by heavy steel beams.

VANCOUVER, B. C.—The management of the British Columbia Electric Railway Company, Ltd., have announced that the interurban line running northerly from Victoria on Vancouver Island will have its northern terminus at Deep Cove, on the Saanich Inlet. This line is 23 miles in length and from it will run a branch to Union Bay, where Meadlands, formerly owned by the late Hon. R. G. Tatlow, will be developed as a residential and pleasure resort. Work on the line is already well under way, a contract for grading 18 miles having been awarded to Moore & Pethick last year, on which operations have been under way during the winter. The line passes through the center of the Saanich peninsula, a district which needs only tram facilities to assure it of rapid development.

MONTEREY, CAL.—News has been received by the local officials of the Monterey and Pacific Grove Railroad, a lately acquired property of the United Railroads of San Francisco, from the Eastern offices of that company directing that work shall begin immediately on the new line between Monterey and Salinas. The new road, which will be electric, will connect Salinas Valley with Monterey, and it is supposed here that it will be part of an electric system which will run from this county to San Francisco. It is reported that the United Railroads has also acquired the Pajaro Valley Railroad, a narrow gauge steam road, which runs between Salinas and Moss Landing. It is the intention to electrify this road and continue it north through Gilroy, San Jose and San Mateo, and thus complete the line to San Francisco.

PORTLAND, ORE.—M. J. Lee, A. O. Echols and O. M. Lee have filed articles of incorporation with the County Clerk under the name of the Canby-Molalla Railway Company. According to plans of the new company, an electric line will be built from Canby through the southeastern section of Clackamas county. Plans of the organization also include the construction of other lines. The company is organized for only $100,000, but it is understood that Eastern and Walla Walla interests are supporting the enterprise. An auxiliary company has announced plans for constructing an immense dam across the Molalla River above Canby for the storage of water for irrigation and power purposes. It is the ultimate plan of these interests to construct an electric line from Canby into the Tualatin Valley district and thence to Portland.

MARYSVILLE, CAL.—The Northern Electric Company has secured quarters here in which to maintain its construction offices while building its new branch railroad to Meridian and Colusa. Bids have been marked for the construction of this road and the contracts are to be awarded March 22. Work is to be commenced immediately thereafter and rushed to completion with all possible speed. The line is to be in operation this year to Meridian, and possibly to Colusa, about 30 miles distant. Particular speed is to be required of the contractors on the section between Yuba City and Meridian, while more time will be allowed on the section from Meridian to Colusa. This end of the line is to be hurried on account of the commencement of the construction work on the Alameda Sugar Company's plant at Meridian. Colusa and Sutter counties will unite with the railroad in the construction of a bridge at Meridian which will span the Sacramento River.

TELEPHONE AND TELEGRAPH.

SAN JOSE, CAL.—The petition of the Valley View Rural Telephone Company for permission to establish pole lines along the county roads in the neighborhood of Valley View was granted.

SAN JOSE, CAL.—The petition of E. D. Franks asking for permission to build a farmers' co-operative telephone line along the county road between Lexington and Los Gatos was granted and the work will be done under the direction of Supervisor Mitchell.

LIVERMORE, CAL.—Cornell & Henry, lessess of Mendenhall Springs, are working up interest in a private telephone line up the Arroyo Mocho. These gentlemen are determined to have a telephone line as far as the springs and they have already secured the promise of a number of farmers and stockmen.

OAKLAND, CAL.—Explaining that the two weeks given in which to prepare a report of the affairs of the corporation as a basis for rate-fixing under the provisions contained in the charter had been insufficient, H. C. Brownlee, district commercial superintendent, and Maynard Bailey, commercial manager of the Pacific Telephone & Telegraph Company, have obtained an extension of time of 60 days in which to gather the necessary data.

FRESNO, CAL.—The completion of a commercial telephone line from Clovis, the termination of the Pacific States telephone lines in the valley, to North Fork, on the San Joaquin River, a distance of 40 miles, is announced. The new line gives public wire connections with the Government forest lines running from El Portal on the north to Trimmers Springs on the south, with 100 miles of wires. H. E. Bigelow, the promoter of the new North Fork line, is to build branches to all the mountain resorts within this field.

SEATTLE, WASH.—The temporary order obtained by the city of Seattle, restraining the Pacific Telephone Company, which has absorbed the Independent Telephone Company, from making physical connection of the two telephone systems, has been dissolved by Judge King Dykeman in the Superior Court. The effect of the order is that the work of the linemen in connecting the wires of the two companies can be carried on without molestation by the city and without a permit from the city. The city alleges that it has a $200,000 interest in the poles, wires and conduits of the independent company under the terms of the independent franchise. Physical connection of the two systems had been practically effected when the temporary restraining order was issued, but since that time the operators when asked by subscribers of one system for a connection with the other have replied that they were forbidden by a court order from making it. A proposal for city ownership and operation of a telephone system was adopted at last Tuesday's election by a vote of 32,498 to 18,163. Mayor-elect George F. Cotterill has expressed himself warmly in favor of a municipal telephone system.

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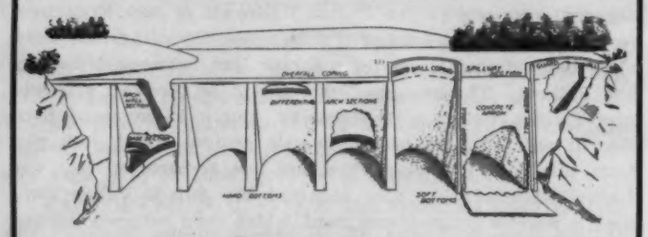

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